RONAUTICS

953 Vol. XLIX

MAY 30th, 1946

See p. 1 This issue

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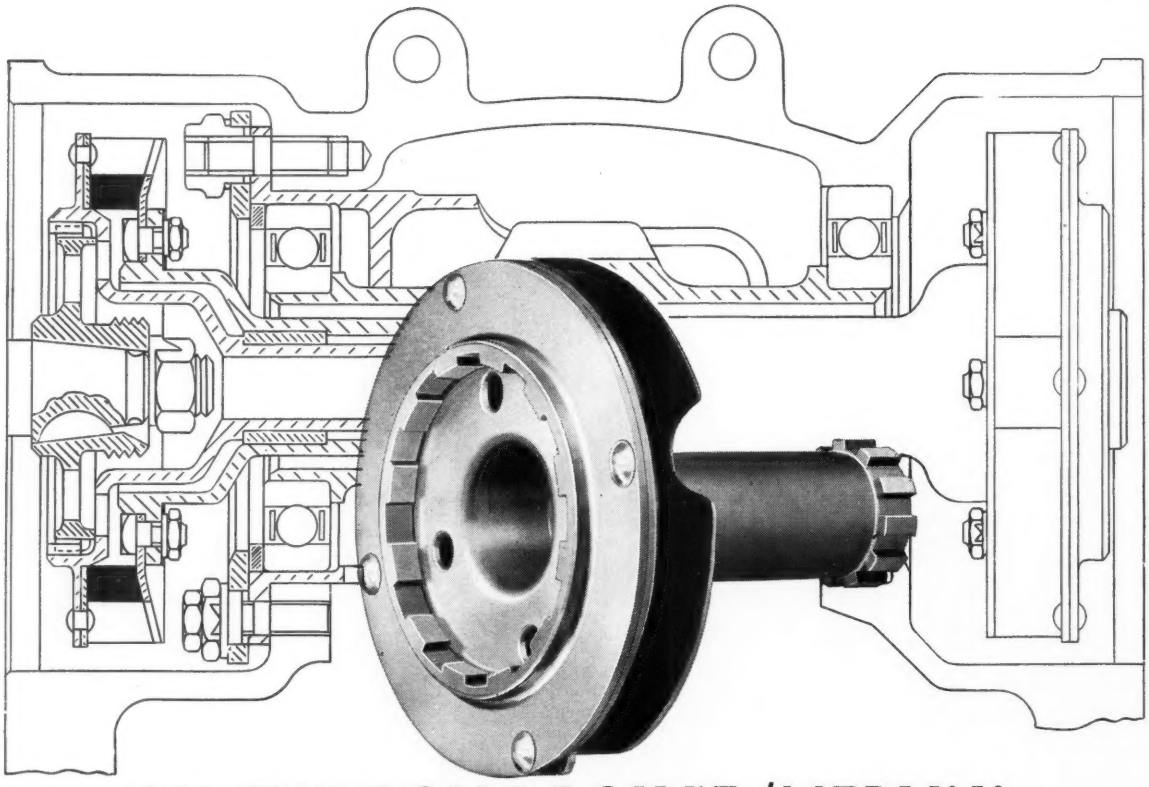

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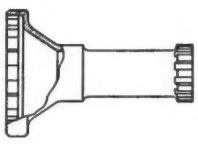

The small line drawing to the left shows the magneto drive as originally planned with a quill drive from the middle of the skew-gear shaft. However, with the increasing vigour of the engine it was found advisable to re-design this coupling to give some torsional cushioning. The photograph in the foreground and the line drawing in the background show the new design with its Metalastik V section coupling. This compact coupling, designed to fit into the existing space, has effectively solved the problem and we have supplied over 100,000 for this famous engine, in addition to couplings and mountings for other situations.

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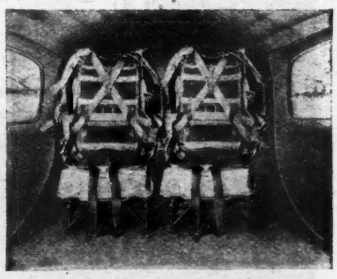

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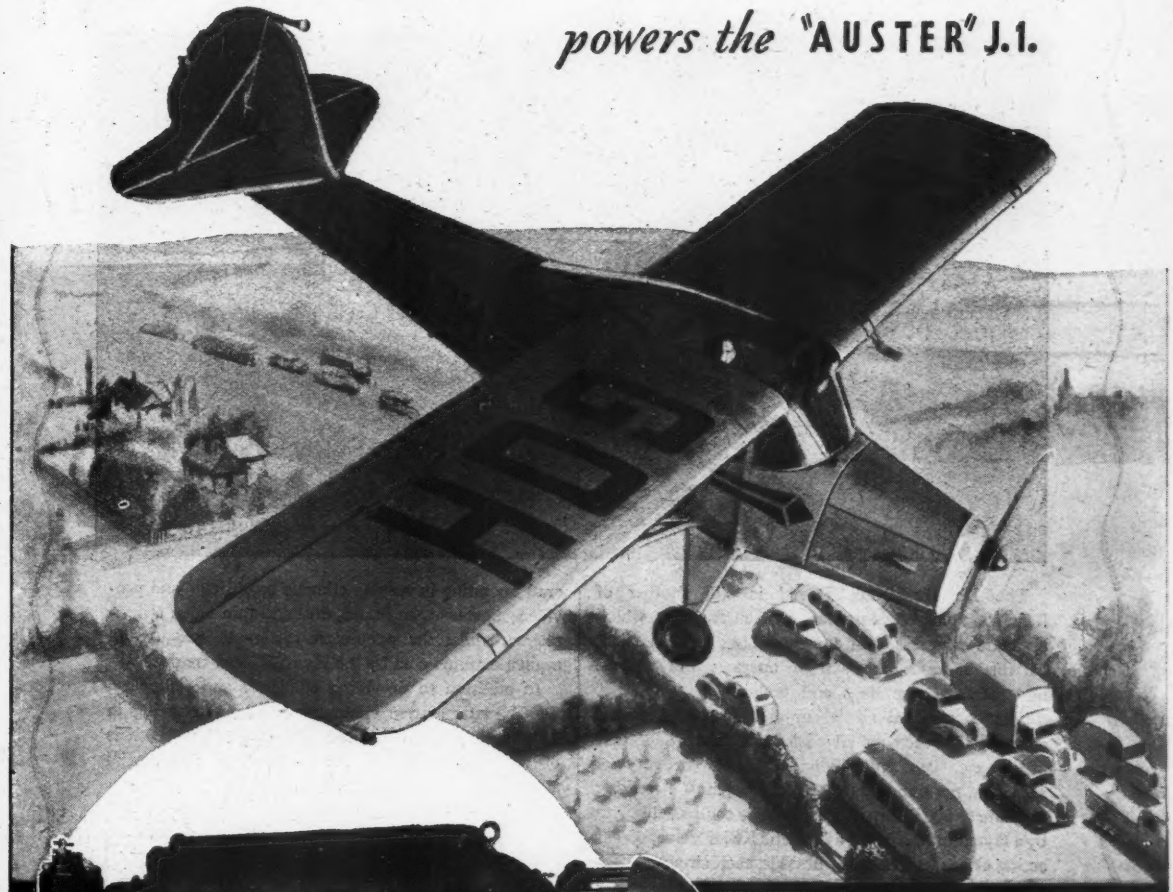

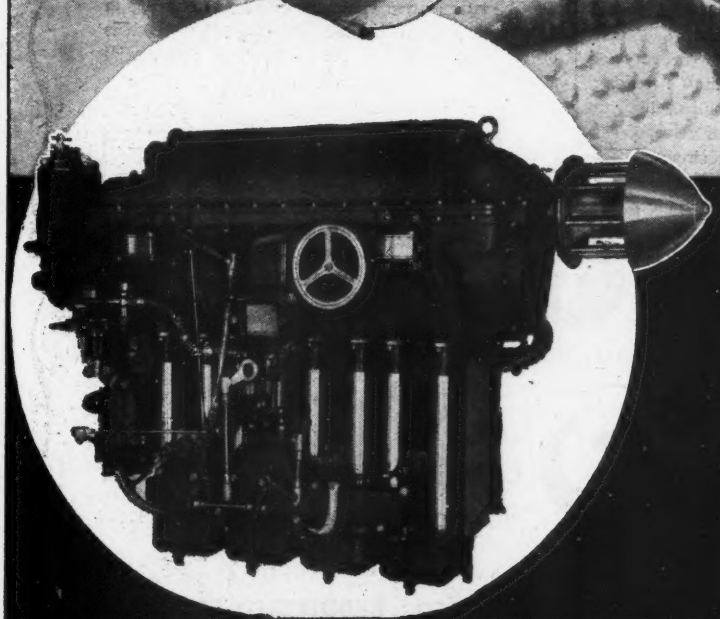

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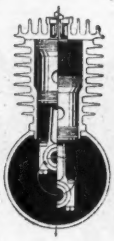

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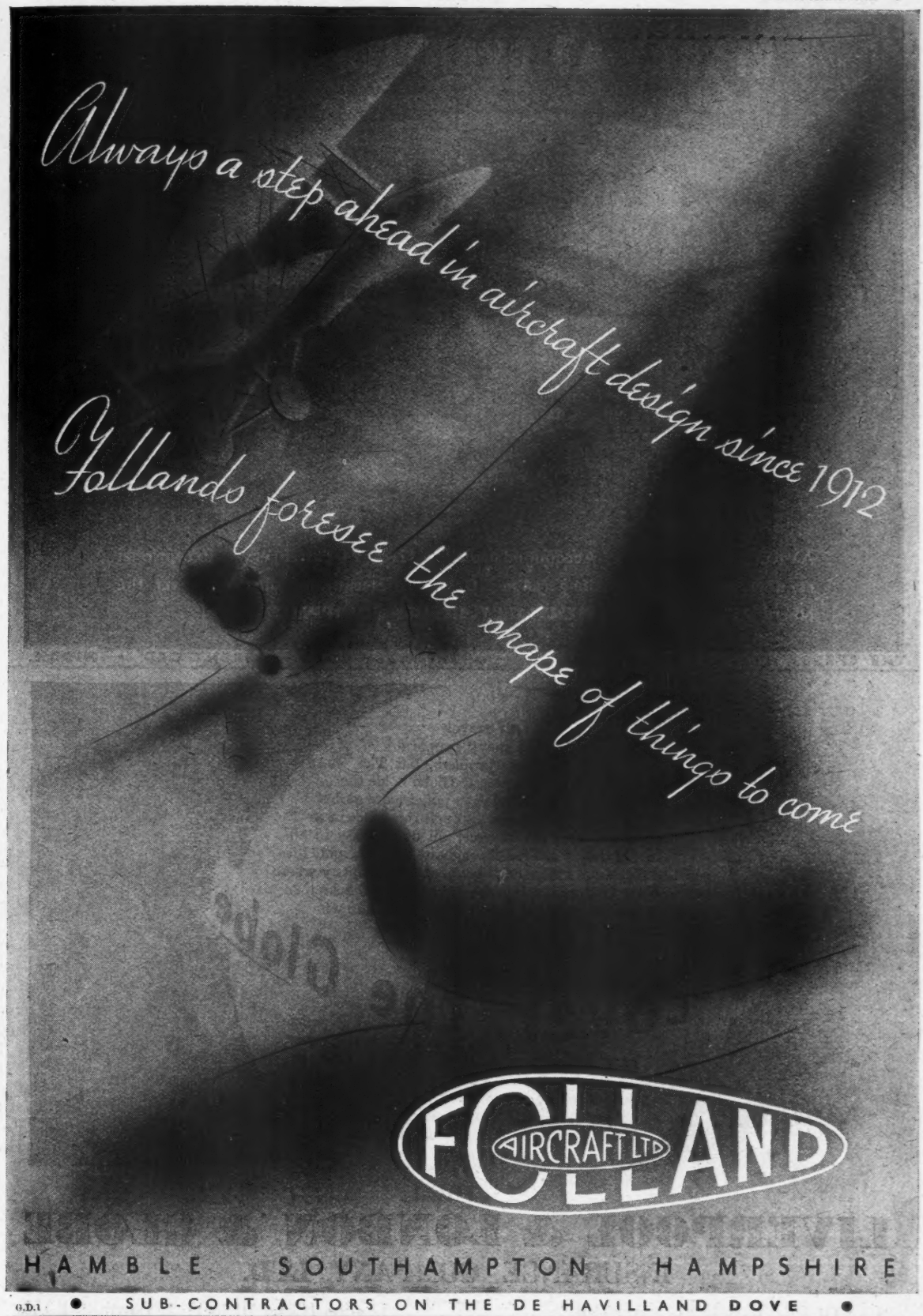
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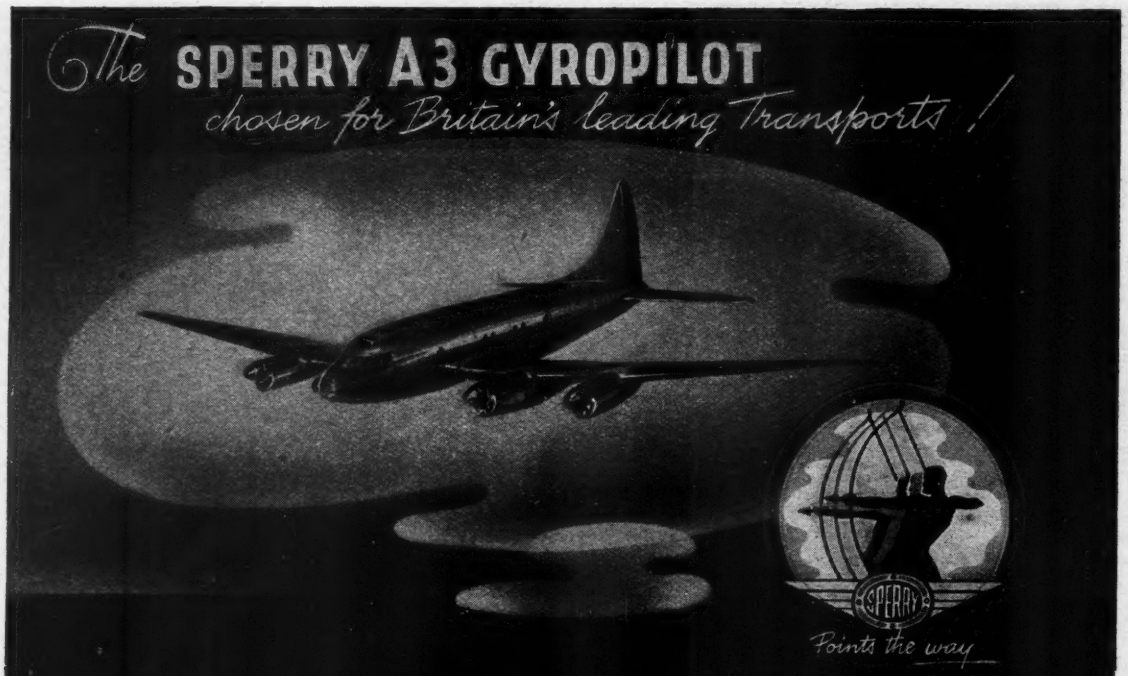

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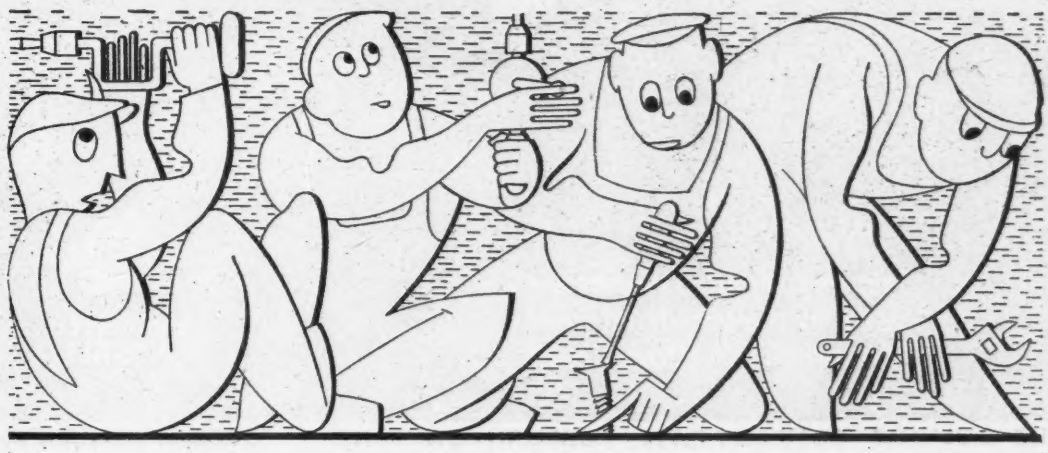

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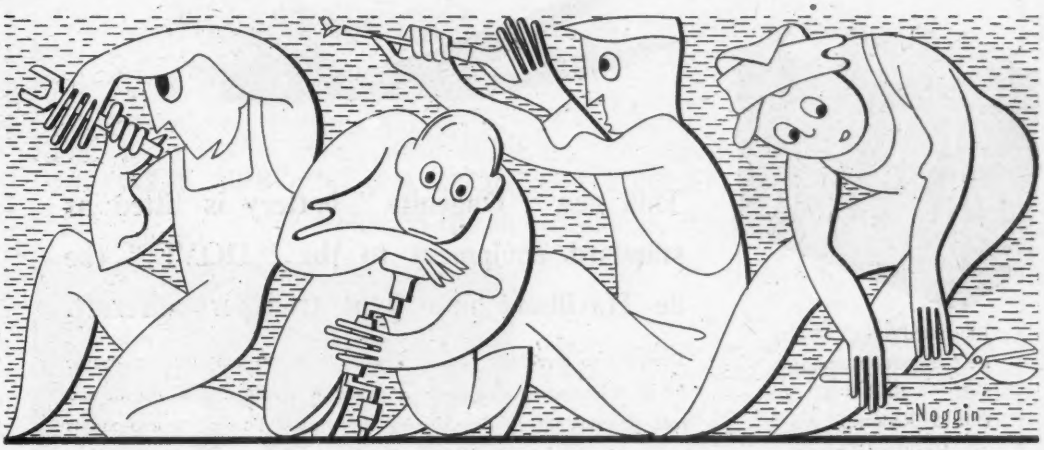

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The Outlook

A Problem of Penetration

SEVERAL spectators at a recent demonstration of the "Grand Slam" Lancaster and Superfortress were puzzled that the R.A.F., and more particularly the U.S.A.A.F., should be worried over the failure of the ten-ton bomb to achieve its calculated penetration in concrete. Such puny weapons, they felt, have been rendered superfluous by the atom bomb, and no enterprising air force has any right to be toying with them in this atomic age. An R.A.F. expert seemed disinclined to discuss the potential destructive powers of an atomic charge in a bomb designed for penetration (anyone's guess, of course, was as good as his), but it was obvious from what he said that deep-penetration H.E. bombs like "Grand Slam" are gaining rather than diminishing in importance. Had the war continued the failure of early patterns to wreck subterranean and concrete-protected installations might have proved embarrassing, as a major part of the enemy's war potential was going underground.

The R.A.F. and A.A.F. are sufficiently concerned about the results of wartime attacks with "Grand Slams" to experiment on an impressive scale, as described in this issue, with new types of concrete-piercing bombs. The U.S. component of a joint enterprise has brought over some 4,500 lb rocket-assisted bombs, but the R.A.F., having experimented with weapons of this sort (developed like the ten-tonner in this country) does not appear vitally interested and is obviously not concerned that "for technical reasons" no British bomber can carry this type. Results obtained by the Germans with their 500, 1,000, 1,400 and 1,800 kg rocket-bombs were not impressive. These bombs, known as the "PC" series, were carried by dive bombers only (Ju 87 and Ju 88) and were used to a limited extent in the Mediterranean theatre. The PC 1,400 (about 3,000 lb) was capable of penetrating about 6½ feet of reinforced concrete, equivalent to some 4½ inches of armour plate.

The outcome of current penetration tests on the U-boat pens at Farge is a secret, but our unique experience with large bombs, the skill of our armament technicians and the co-operation of the Americans (and, for that matter, of the Germans, in supplying a ready-made target) can hardly fail to establish the reason or reasons why big bombs are not achieving their calculated penetration.

Equipment versus Payload

WITH the ever-increasing number of safety requirements and regulations to fit civil aircraft for international operation, the moment is rapidly approaching when the evolution of a medium-sized feeder-line type will, far from being the easiest, become most difficult of all projects for the designer.

The designer of a civil aircraft of less, say, than 10,000 lb all-up weight is nowadays faced with very considerable problems. If the aircraft is to be used on very serious day-to-day services it must carry all "standard" items of equipment, such as radio and de-icing gear, which, with all the myriad odds and ends of ancillary services, are necessarily almost as heavy for an aircraft in this size as they are for one in the 100-tonner class. He must also design his aircraft so that it will fulfil the full-size safety requirements involved in dealing with possible engine failure immediately after take-off.

Consequently, in order to obtain a good proportionate payload in a small aircraft, the greatest possible care must be taken in the choice of means by which the structure and other weights can be kept down without the loss of maintenance ease or an increase in manufacturing costs.

In the Dove, which is described in this issue, it may be that the limits, in the balance between payload and modern equipment in such a small size, have been almost reached. Though it is likely that the development of small-output airscrew-turbines will alter this

balance, we have probably, for the time being, reached something like finality with present methods of construction. In the meantime the designers of the Dove are to be congratulated on the result of their efforts to achieve the almost impossible.

Another Brabazon

WITH the successful appearance of the first of the Miles Marathons—described on pp. 545-546—there are now two of the Brabazon series in the air and covering the requirements in the medium-range and medium-capacity classes. As far as can be gathered, the prototype Marathon's performance is well up on expectations, and we hope that, by now, orders of a useful nature have been placed.

The initial request was for three aircraft. These are being built singly and the second prototype is on the way towards completion. With time at a premium, however, it would surely have been better if a somewhat firmer production order had been placed. As it is, there will be a considerable delay before the type can be offered to operators here and abroad.

In any free-for-all system it would have been natural for individual operators to await the results of first tests before placing any orders, and for the makers to consider series production only after the success of the prototype had been assured. Since, however, the Government has nationalized the air services, the Government is obviously the only serious domestic purchaser of transport aircraft, and encouragement, in these circumstances, should be more useful and definite if we are really to get on with the business of world air transport.

Tented Terminal

TOMORROW, Pan American World Airways and American Overseas Airlines are switching their transatlantic terminal in this country from Hurn to the London Airport. On the face of it, this is a step in the right direction for it brings transatlantic passengers within comparatively easy reach of London, and eliminates the tedious motor-coach journey from Hurn.

There is, however, another side of this move to be considered, and that is the lack of accommodation and the poor passenger-handling facilities at the Heathrow site. In fact, for many weeks to come, the American operators will have to content themselves with passenger accommodation composed of tents, augmented by more tents and a caravan or two for their own staff. It is understood there are promises from the Ministry of Civil Aviation of temporary buildings by mid-July, and we hope that these promises will be fulfilled. Nevertheless, there is little cause for congratulation in the fact that transatlantic services are operating into Heathrow, when the only accommodation which can be offered to the passengers before or after a transatlantic crossing is tents.

One could perhaps adopt a more charitable attitude to such interim measures if passenger-handling facilities at our other airports were good, but as the whole world knows, they are not. It is a lamentable fact that at Croydon, Northolt, Hurn and now at the London Airport, makeshift accommodation is being endured both by civil airline operators and their passengers.

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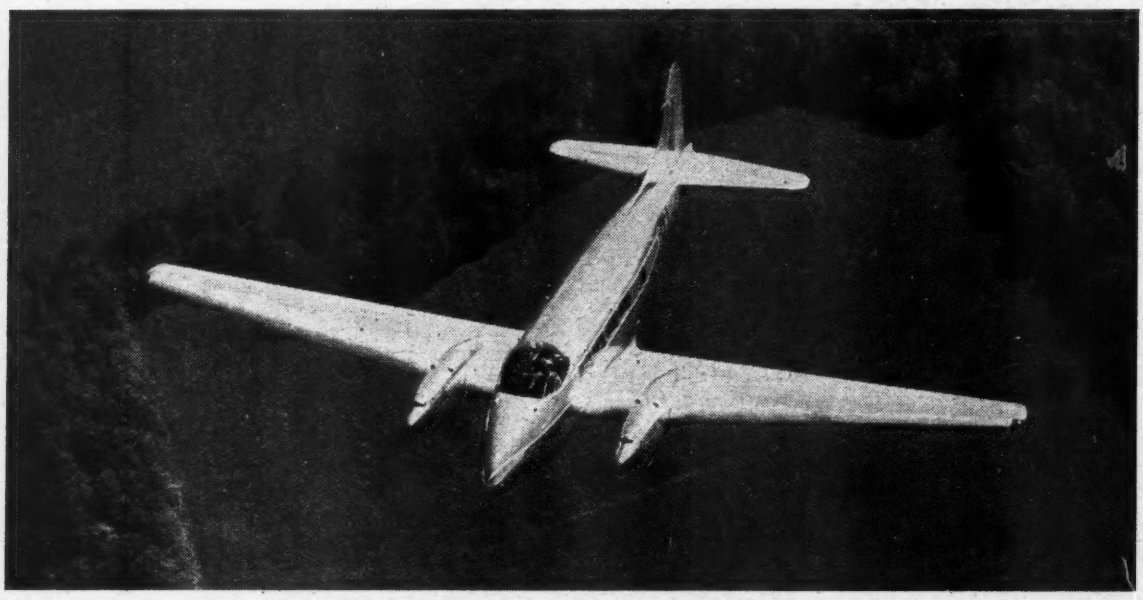
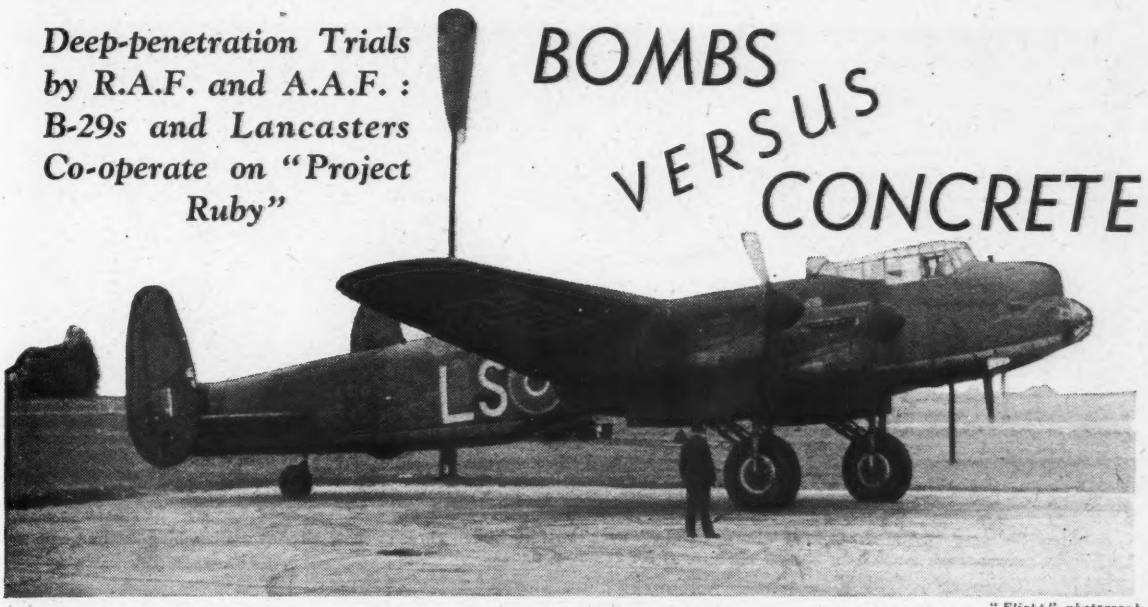


SCALED-DOWN TRANSPORT: The De Havilland Dove, now in production, is the result of a successful attempt to offer modern airline equipment standards in the feeder-line class. An illustrated description and some actual handling impressions appear on pp. 546a-549. This view of the "production" Dove gives a good idea of its lines.

Deep-penetration Trials by R.A.F. and A.A.F.: B-29s and Lancasters Co-operate on "Project Ruby"

BOMBS VERSUS CONCRETE



"Flight" photograph

One of the specially modified Lancasters of No. 15 Squadron now operating against the U-boat pens at Farge. The bay for the 22,000 lb bomb has no doors but is faired fore and aft. Only the tail turret is retained.

SUCCESSES achieved by the R.A.F. with heavy bombs designed for deep penetration are already history. Bridges, tunnels, V-weapon sites, canals, dams, capital ships, U-boat and E-boat pens all came under attack with those peculiarly British weapons "Tallboy" and "Grand Slam" and the course of the war was tangibly altered by their effect, but when targets were examined and results assessed, the R.A.F. was disappointed and frankly a little mystified by the behaviour of their heavyweights on impact with thick concrete.

Penetration in many cases was not effected, but whether due to the breaking-up of the bomb case or to over-sensitivity of the explosive filling, causing detonation on impact despite delay fusing, could not immediately be established. U.S. Army Ordnance experts were similarly baffled and, as in the resolution of other common difficulties, it was agreed to study the problem jointly. Organization and co-ordination were vested in R.A.F. Bomber Command, and each country undertook to provide suitable aircraft, bombs and facilities. Although small U.S. bomber forces remained in England it was necessary in March this year to form at Eglin Field, U.S.A., a special force comprising three B-29 Superfortresses, seven B-17 Fortresses, three C-54 Skymasters and 160 officers and men. Under the code name "Ruby," and with Lt. Col. D. G. Hawes in command, the formation was drafted to the R.A.F. Central Bomber Establishment, Marham, to join 15 Squadron, R.A.F., equipped with specially modified Lancasters.

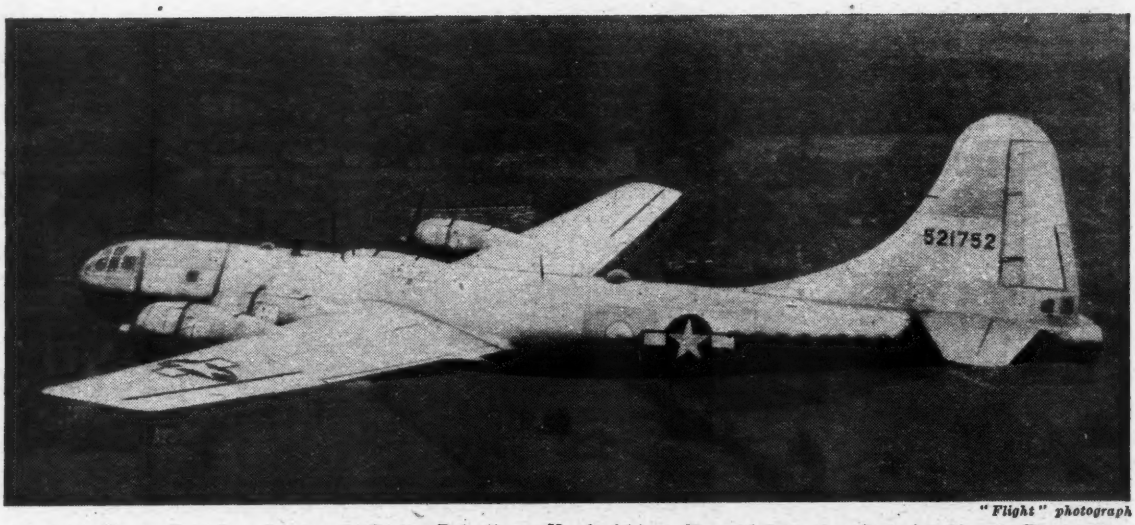
A bombing programme was initiated against the uncompleted U-boat pens at Farge, near Bremen, and other heavily protected targets, and about 140 sorties have already been flown. Previously the R.A.F. had used the V-weapon site at Watten for penetration tests, but the good people of France, having by that time received their quota of bombs, justly protested. In any case, the Watten structure was barely thick enough to offer the required resistance.

A TEN-TON BOMB dropped from 40,000ft would penetrate 130ft in soil. The resistance of only 50ft of soil is equivalent to about 8ft of concrete or 5 inches of armour.

The Farge U-boat pens, now occupied by an R.A.F. detachment, were never used during the war and are of a particularly modern type of construction. The main structure is 1,320ft long, 300ft wide, 75ft high, has 14ft walls and a roof which varies in thickness between 15 and 23ft. The constructional material is concrete, with massive steel reinforcing frames, and the only damage resulting from R.A.F. attacks during the war was two small holes in the roof made by 22,000-pounders.

The Lancasters of No. 15 Squadron are now attacking with the latest types of British deep-penetration bombs, mainly 12,000- and 22,000-pounders, in various combinations of height, fusing and filling. The trials are designed not only to determine whether the

British and American experts assess the limited damage to the Farge U-boat pens resulting from two "Grand Slam" hits.



"Flight" photograph

A stately Boeing B-29 Superfortress of "Project Ruby" over Hertfordshire. Three of these aircraft are bombing the Farge pens with 22,000-pounders.

casing or filling is at fault but to provide data on the resistance of concrete to "hammer" blows. Technical details of the bombs are withheld, but the story of their development is illuminating.

In 1941 the largest penetrating bomb available to the R.A.F. was the thousand-pounder. True, a small number of 2,000-lb armour-piercers existed, but although these had a very small charge/weight ratio they were designed primarily for use against ships. The thousand-pounder could not reach any great depth and dissipated a great deal of energy upwards in forming a crater. It was realized that if the same bomb could be made to penetrate deep enough to cause a spherical cavity in the earth, energy dissipation would be more in the form of a pressure wave, with "earthquake" characteristics, but the small weight of the bomb prevented this being achieved.

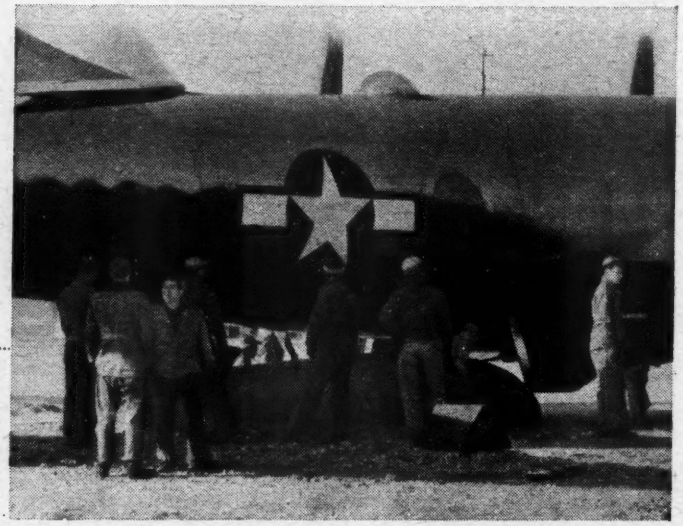
BOMBS VERSUS CONCRETE

During the same year Mr. Wallis, of Vickers-Armstrongs, Ltd., produced calculations for a bomb to use a pressure wave for its destructive value, rather than cratering and fragmentation. He calculated that the depth of penetration should be about 130ft in ordinary soil, and specified a ten-ton bomb to contain about six tons of explosive. Released from 40,000ft, he considered that this would produce the desired pressure effect, causing underground installations to collapse, though not directly hit. At that time, of course, no R.A.F. bomber was capable of carrying the load to the required height and for the necessary range, but the project was not forgotten.

Two years later the Germans, harassed by thousand-pound bombs, began to burrow underground and to protect vital installations with thick concrete. Still the R.A.F. had no aircraft capable of carrying a ten-ton bomb to 40,000ft, though the goal was half reached. Thus a compromise was indicated and took the form of the 12,000-pounder carried by the Lancaster. Credit for this development must go not only to Mr. Wallis but to Mr. Roy Chadwick, the English Steel Corporation of Sheffield and Air Chief Marshal Sir Wilfred Freeman, then Chief Executive of M.A.P.; this was made clear by Group Captain Wynter-Morgan, likewise intimately concerned with the bomb's development, during a demonstration at Bovington of the modified B-29 and Lancaster. Early in 1944 the 12,000-pounder was in production and the first bomb was used by 617 Squadron against the Saumur tunnel in June. The mouth of the tunnel was caved-in completely by a near miss within 30 yards, and the results were such that the bomb, hitherto produced solely on the authority of Air Chief Marshal Freeman, was officially "adopted" by the Air Staff.

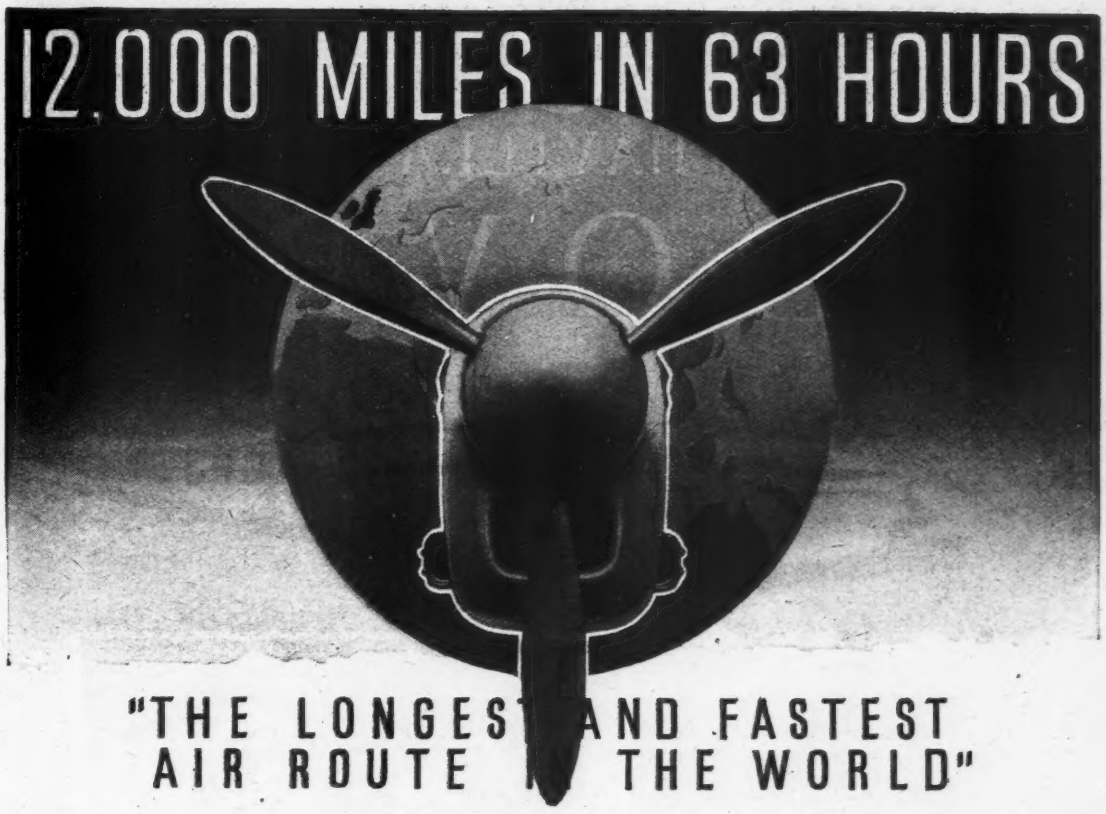
"Grand Slam" Resurrected

The operational ceiling of the Lancaster carrying a 12-000-lb bomb was at that time 16,000 to 18,000ft and was insufficient to afford the necessary striking velocity to penetrate to depths which would produce the maximum pressure wave. Nevertheless, it was decided to resume work on the 10-ton bomb and to use it against the heavily protected V-weapon structures in France. Early in 1945 one of these monsters was aimed at the Bielefeld viaduct, a massive structure carrying a strategic railway. In two attacks within three weeks seven spans were destroyed by near misses, which, although producing craters, were, as the Air Ministry put it, "well on the way to destroying structure by pressure-wave effects." Hundreds of tons of smaller bombs had been expended on the viaduct, but even



The low build of the Superfortress necessitates the use of a pit for the bombing-up with a "Grand Slam."

12,000 MILES IN 63 HOURS



"THE LONGEST AND FASTEST AIR ROUTE IN THE WORLD"

With the arrival at Hurn Aerodrome on Saturday, 2nd March, of the B.O.A.C. "Lancastrian" from Australia, the 100th flight in each direction of the longest and fastest air route in the world was completed.

The 12,000 mile trip was made in 63 hours.

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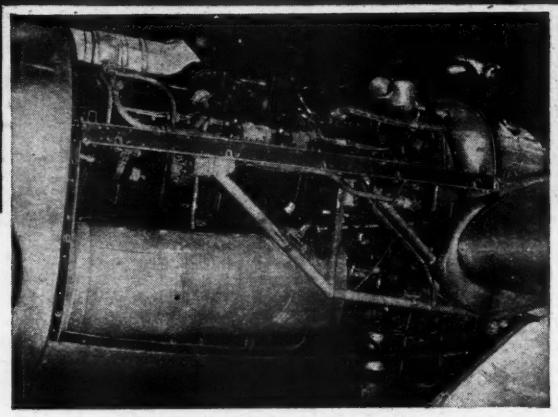

THE NEW DE HAVILLAND DOVE LIGHT FEEDER-LINE AIRCRAFT, ILLUSTRATED ABOVE, IS FITTED WITH TWO DE HAVILLAND GIPSY QUEEN 71 SUPERCHARGED AND GEARED ENGINES OF 330 H.P. EACH . . .

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BRANCHES THROUGHOUT THE COUNTRY

BOMBS VERSUS CONCRETE

direct hits had done little damage and were easily repaired.

Attacks with 22,000-pounders continued, but the war ended before the implications of bomb versus concrete were fully resolved, and it was apparent that more empirical data were required if the full benefit from research was to be derived; this consideration led to the present trials.

The U.S. component is dropping bombs ranging from 2,000 lb to 22,000 lb (the British-designed "Grand Slam" was quantity-produced in America) in addition to a new type of 4,500-lb rocket-assisted armour-piercing bomb, two of which are slung externally under the wing roots of a B-17. The rocket motor is cut in at a predetermined height after release and a direct hit is essential to effectiveness. An official film of "Project Ruby" shows that the missile resembles the German "P.C." series carried by Ju 87s and 88s, though the rocket motor, detachable from the warhead, appears even longer. For "technical reasons" no British aircraft can handle this bomb.

To stow the 22,000-pounder the B-29 has a redesigned bomb bay with special doors through which the body of the bomb protrudes. The installation is more refined than that on the Lancaster, but the squat build of the aircraft renders it necessary to place the bomb in a pit to obtain loading clearance.

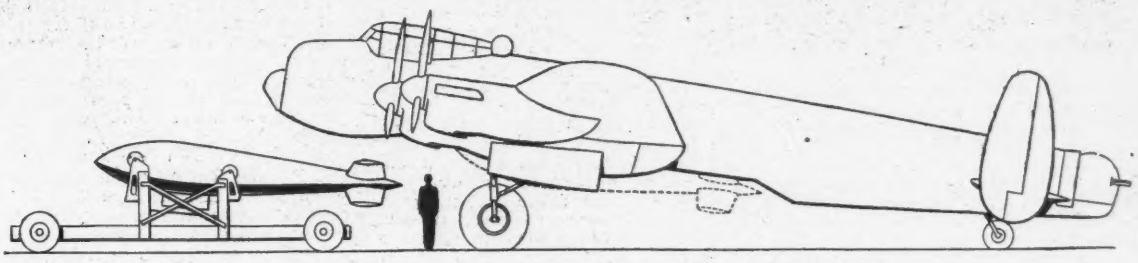
Scathing comment concerning bomb loads and ranges of American bombers is still heard, and in fairness it must be recorded that towards the end of the war B-29s were operating against Japan with 4,150 gallons of fuel and 20,000 lb of bombs. When the type first went into action the load was 6,175 gallons and 5,000 lb, the improvement being due to strict operational procedure laid down for the guidance of pilots. In the early days there was a difference of up to 400 gallons used by an experienced and inexperienced crew on the 14-hour flights necessary at this stage of the Pacific war.

Certainly the B-29, vehicle for the atomic bomb and holder of the long-distance record (8,198 miles in 35 hr 5 min) was one of the war's great aircraft. Had the atomic bomb not shattered Japan's resistance the type would have gone into action within a fortnight carrying one 22,000-pounder, and experiments were in progress to increase the load for Japan to two external "Grand Slams." Experimental flights had, in fact, already been made with this load.

It was a delight to fly from Bovington last week in a B-29 of "Project Ruby," with the Commanding Officer as pilot. The quiet of the forward pressure cabin, excellent view for the pilots, and speed, even at low altitudes, made a specially deep impression.

On the ground the squat sleekness of the black and silver Boeing is accentuated by the compact aggressiveness of the drab "Grand Slam" Lancaster with its permanently open bomb bay gaping for the ten-tonner and stripped of all armament but the tail turret. This was the willing warhorse which showed how to deliver large bombs to distant targets with consistency, accuracy and effect, and which is now the means of proving the newest weapons in the R.A.F. armoury

At a take-off weight of 72,000 lb the "Grand Slam" Lancaster I has a range of 1,550 miles at 15,000 ft, cruising at 200 m.p.h. This is achieved on 1,675 gallons of fuel, of which 330 gallons are used for climb, 720 for the outward journey and 625 for return. Less fuel, oil and bombs, the aircraft weighs 36,457 lb (thus it lifts approximately its own weight), and at 19,000 ft over the target, before release of the bomb, the weight is still 66,900 lb, only about 1,000 lb less than the take-off figure for a normal operational Lancaster.



The 22,000 lb. "Grand Slam" is loaded on the specially modified Lancaster from a special trolley, shown to scale in the above drawing. The configuration of the Lancaster will interest recognition enthusiasts.

Preparing for the Fly-past

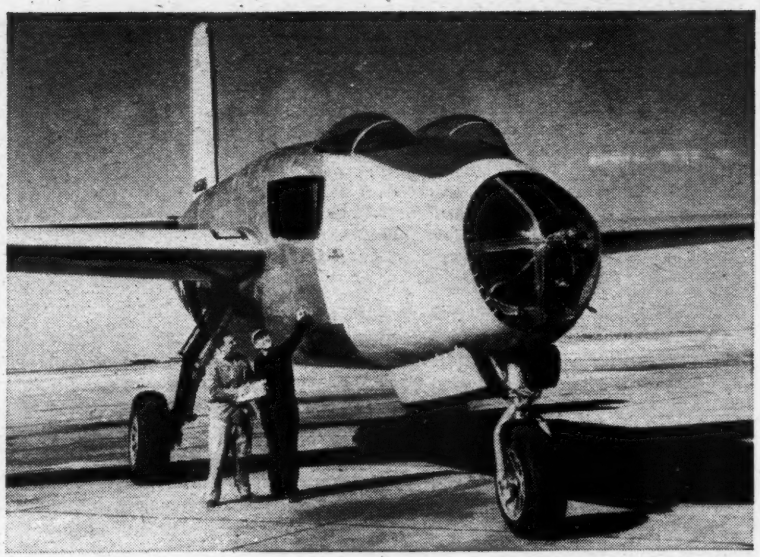
UNDER the control of No. 11 Group, Fighter Command, rehearsals for the Victory Day R.A.F. fly-past are now taking place almost daily. This will be the first large-scale R.A.F. ceremonial fly-past before H.M. The King. In view of the strict time limits set for each squadron (a 30-sec. allowance on schedule) and the very considerable problems in connection with the control and co-ordination of the 300 aircraft taking part, every phase from forming up to dispersal after passing over the saluting base must be rehearsed by each Squadron. There will be no full-scale try-out over the entire route but in skeleton rehearsals the leaders of each formation represent the squadrons. Full squadron practices are taking place around the countryside and these will be valuable to 11 Group H.Q. in solving the problems resulting from the wide variation in optimum speeds between flying boats and jet fighters, to mention the extremes.

In view of their relatively short duration Vampires and Meteors are making take-off and landing trials from their bases near London to ascertain exactly what quantity of fuel they will require and how long their flights will take.

As a result of special G.C.I. control arrangements and the provision of a line of sodium flares on police and railway stations between Romford and the Admiralty Arch, the fly-past, or at least part of it, will take place even if weather is inclement. The limiting conditions are likely to be a 1,500ft minimum cloud base for forming up and 800ft over London with visibility in the order of 3,000 yards. Very high-speed aircraft are most liable to cancellation, as screen-wipers cannot be fitted and visibility in rain is very limited. Visual contact is required to maintain station in the main formation over the saluting base. Three squadrons should be visible at a time, one overhead, one coming from the East and one disappearing westwards.

Some forty-five squadrons will take part and the aircraft, led by one Hurricane flown by a Battle of Britain pilot, will include a small number of Sunderlands and Lancasters, some Naval Air Arm Firebrands, Fireflies, Seafires and Sea Mosquitos and from Fighter Command, a squadron of Vampires, one of Hornets and larger numbers of Spitfires, Tempests and Meteors. The Vampires will bring up the rear.

HERE AND THERE



JET BOMBER: Developed from the XB-42 "Mixmaster," with twin Allison piston engines, Douglas's new jet-propelled bomber, the XB-43, has "nostril" intakes to its twin units. From the dimensions of the fuselage these are presumed to be of axial-flow design. The undercarriage retracts rearwards into the fuselage and the pilots have "bugeye" enclosures, characteristic of the newest Douglas designs.

Additional "Ghost" Data

FOUR more items of data on the Ghost gas turbine engine have just been released for publication by the De Havilland Aircraft Co., Ltd. They are as follows:—

Overall length 122⅝ in, overall diameter 55 in, net dry weight with engine auxiliaries and tail pipe 1,950 lb, and fuel consumption 1.051 lb/hr/lb thrust.

Java Rescue

THE first batch of 203 civilian internees from the internment camp at Soerakarta, central Java, were flown out of captivity last week by five British aircraft, says a Netherlands News Agency message from Batavia.

The internees are being taken in relays to Batavia and Semarang, where most of them are being housed for the time being aboard converted tank-landing craft.

For V-Day Visitors

THE exhibition of German aircraft and other aeronautical equipment in the Science Museum, South Kensington, is to be extended until the end of June so that Colonial and Dominion D-Day visitors to London may have a chance to see it.

Already nearly 500,000 people have seen this exhibition which was at first confined to German types but has been supplemented by examples of recent British designs including the original Whittle jet engine.

Composite Sales Service

"AUTOMOBILE AND AIRCRAFT SERVICES, LTD.," is the title of a new company formed for the purpose of supplying customers with the most suitable car or aircraft. The firm, chairman of which is Major R. H. Mayo, of Short-Mayo Composite aircraft fame, intends not only to supply the car or aircraft in the first place but to give after-sales maintenance service.

There are many business houses, and not a few private individuals, who are thinking of acquiring their own aircraft. Not all of them are sufficiently familiar with the different types to be in a position to judge which is likely to meet their particular requirements, and the new firm will give an unbiased opinion, supply the aircraft, and undertake subsequent servicing and maintenance.

Managing director of A.A.S. is Mr. Jack Mayo, a cousin of Major Mayo, and the sales manager is Mr. W. G. Pearson, who served in the R.F.C. in the first world war and in the R.A.F. in the second. Temporary offices are at 45, Dorset Street, London, W.1, but the permanent head office will later be in St. James's Street, where there will also be showrooms.

Telling Europe

AIR COMDRE. FRANK WHITTLE'S lecture on "The Advent of the Aircraft Gas Turbine," given to a public audience in Rotterdam yesterday, was the fifth of a series he has been giving on the Continent during the past fortnight.

He gave his lecture to public audiences in Antwerp and Liege, while another on "The Early History of the Whittle Jet Propulsion Gas Turbine" was given to the *Societe Royale Belge des Ingenieurs* at Brussels, and to the *Koninklijk Instituut van Ingenieurs* at The Hague.

Mr. H. M. Woodhams Honoured

THE election of Mr. H. M. Woodhams, C.B.E., director and general manager of Armstrong-Whitworth Aircraft, Ltd., to a Fellowship of the Royal Aeronautical Society comes as a recognition of nearly 40 years' activity in the aircraft industry.

Starting his career in 1909, he acquired during the pioneering stages of air travel a thorough grounding in the engineering and flight sides of aircraft operation, a typical instance being his 12,000-mile flight with Sir Alan Cobham in 1923 through North Africa to the Near East.

At Mildenhall

THE general public were admitted to Mildenhall R.A.F. Station last Saturday for the second time since the war when the officers and aircrew staged an exhibition in aid of St. Dunstan's Homes.

For the modest admission charge of 1s (children half-price) visitors were able to inspect such wartime inventions as the Japanese "Baka" suicide aircraft and the German V1 flying bomb, besides a wide range of R.A.F. equipment including a "stripped" Lancaster.

Trials Completed

THE new Hermes/Hastings transport returned to the Handley Page airfield at Radlett last week after completing its trials at Wittering, having gone through all its handling, stability, light and full load tests in only a fortnight.

The Hermes version will be furnished to carry 34 to 50 passengers and their baggage, while the Hastings military transport will be equipped to carry paratroops or motor lorries, guns, etc.

"Target Array"

THE above is a delightful example of what the American can achieve in the way of descriptive terms to cope with the unprecedented. It refers to the conglomeration of ships to be used in the first atom bomb test at Bikini Atoll this summer—patently something far too wide to be covered by the single word "target."

Observers and reporters, by the way, are to have a full view of the "target array" from air and sea, but Vice-Admiral W. H. P. Blandy, commander of the U.S. Atom Bomb Test Task Force, has announced that information on a number of vital points will be restricted, including the more significant distances and detailed photographs showing the damage done.

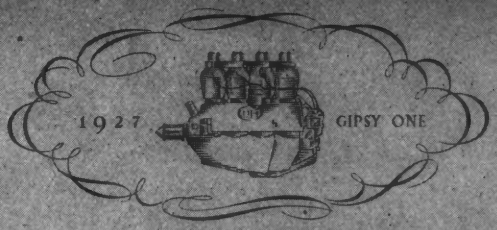
Our Soviet Friends

EVEN those with the most fervent admiration of Russia and the Soviet system must be at least a little puzzled by some of the propaganda emanating from that country from time to time.

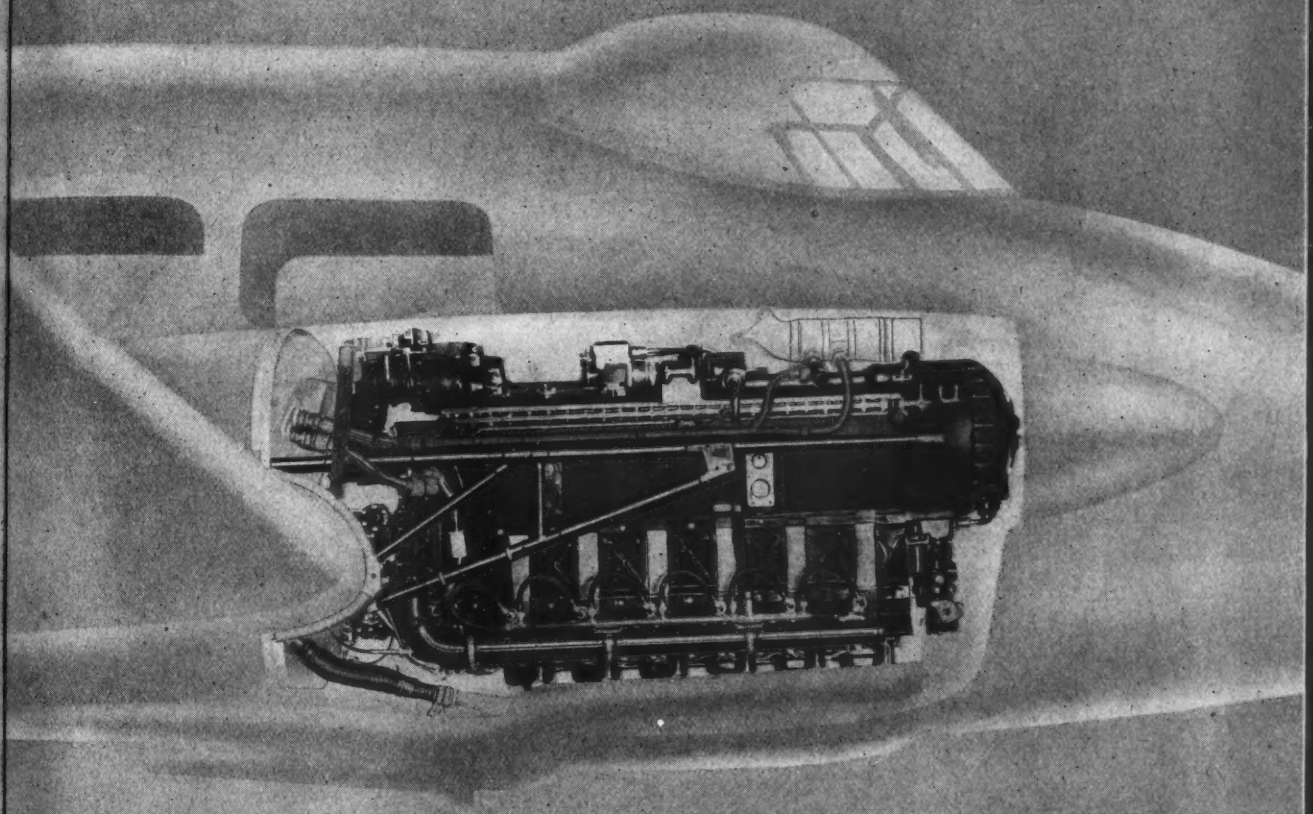
The latest example of our gallant ally's friendliness is a statement made in a lecture given in Moscow last week by Ivan Yermashev, one of their political commentators:

At Essen, said Mr. Yermashev, 60 per cent of the British and American bombs fell not on the Krupp steel and armament works but on dummy factories. In fact the Allied bombing of Germany did

FLIGHT
May 30,
1946
Advt. i.

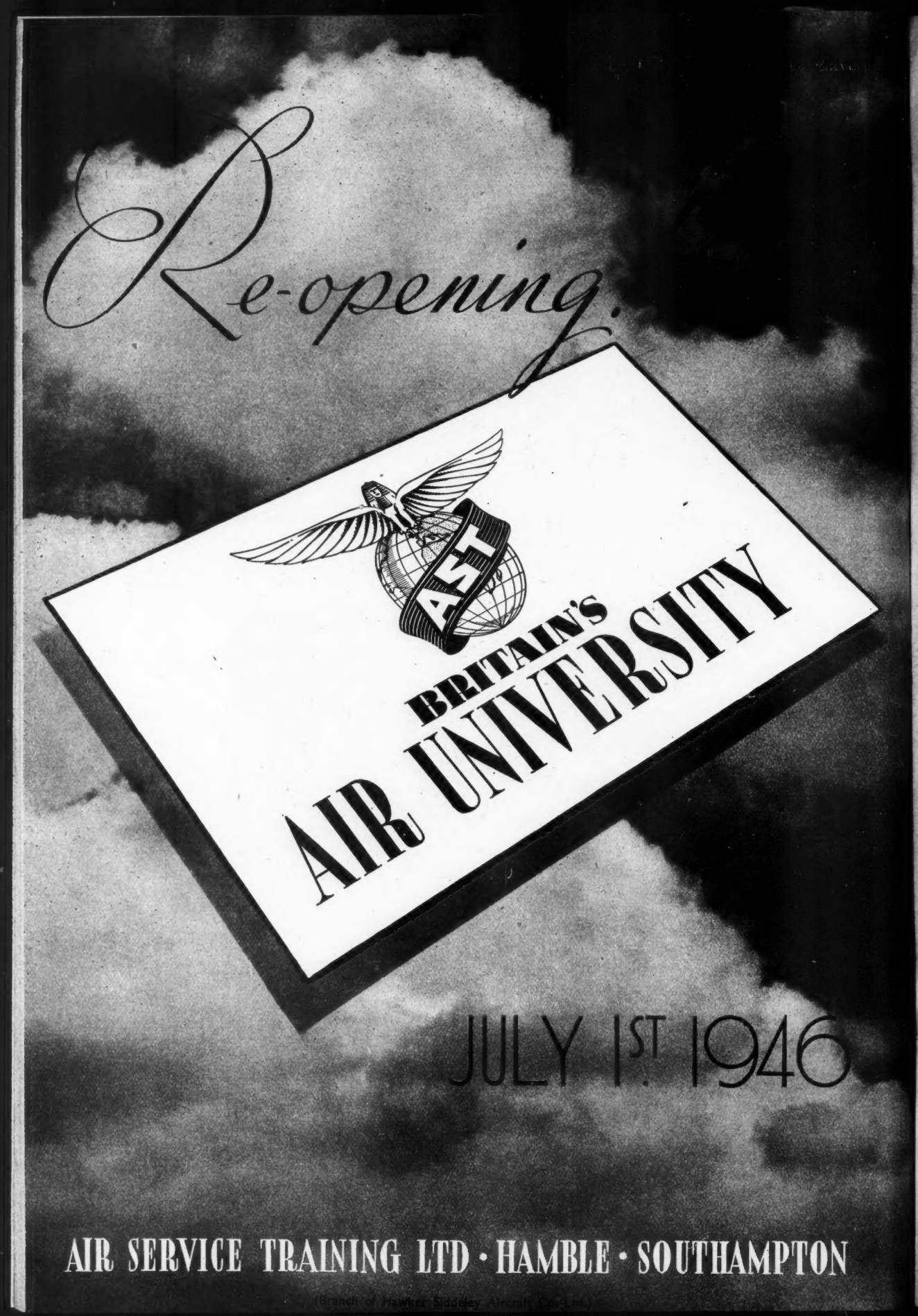


Clean entry and low frontal area for efficient aircraft performance



de Havilland Gipsy Queen Series 70 geared and supercharged engine 330 b.h.p.

THE DE HAVILLAND ENGINE COMPANY LIMITED


Re-opening
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HERE AND THERE

not seriously affect the outcome of the war and only "somewhat reduced" German industrial might.

This friendly hug from the Russian bear leaves us too breathless for adequate comment, but Goebbels would surely have cackled with gleeful admiration.

Disposal of Surplus Equipment

A NUMBER of enquiries have been received by *Flight* with regard to the disposal of surplus equipment by the R.A.F. and other Services.

The control of this work comes under the Director-General of Disposals at the Ministry of Supply, Thames House, Millbank, S.W.1, and all enquiries should be sent to that address.

It will be realised that the Ministry is chiefly concerned with the disposal of surplus stores in bulk through trade channels, and requests for individual articles can only be considered in exceptional circumstances.

GAS TURBINES and JET PROPULSION FOR AIRCRAFT

By G. Geoffrey Smith, M.B.E.

A FOURTH Edition of this pioneer work, first published in 1942, has now gone to press. Copies will be available in the course of a few weeks.

Greatly enlarged, the new edition carries the development of aircraft gas turbines up to the present day and also envisages future possibilities in regard to both propulsion units and aircraft.

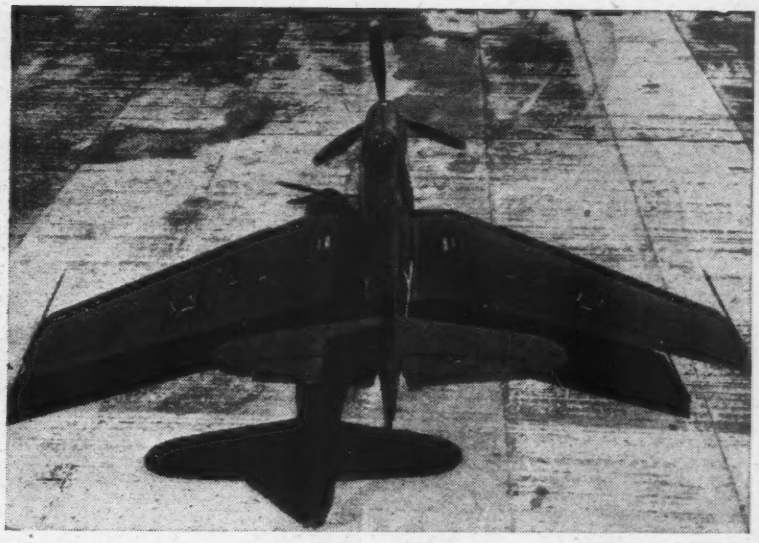
General principles of jet propulsion, thrust and performance, rotary components, combustion systems, fuel equipment and control, metallurgical problems and testing and maintenance are dealt with in the early chapters.

Descriptions are included of all existing turbine units, both pure jet and airscrew types, in this country and abroad.

The relative merits of jet and airscrew propulsion, the problem of high speed flight, the influence of turbine power units on aircraft design and the probable development of flying wings and tailless types form an important section.

The previous editions, two of which were also published in the U.S.A., have for some months been completely exhausted. They have been adopted as the standard text by numerous universities, technical institutions, libraries and both governmental and commercial training centres.

Further announcements relating to the new edition will be made later.



SUPERSONIC SLANT: The Bell L-39, a modified version of the P-63, which has been developed in co-operation with the U.S. Navy Bureau of Aeronautics in experiments aimed at supersonic speed. The backswept wings are set at 35 degrees.

News in Brief

Some of the bookings for Pan American's service between New Zealand and San Francisco (resumed last Saturday), of which there were over 200, were made as long ago as 1942 and deposits paid on them.

* * *

Sir Frederick Handley Page will be the guest of honour and chief speaker at a luncheon arranged by the Gauge and Tool Makers' Association for its 200 members and their guests at the Savoy on Wednesday, June 19th.

* * *

Messrs. Geoffrey and Brian Rootes, sons of Sir William Rootes, who were recently demobilized from the Army with the rank of Major, have been appointed directors of Rootes Securities, Ltd. They were on the executive staff of the organization before the war.

* * *

The Danish aeronautical expert, J. C. Ellehammer, who claimed to have made the first flight in Europe in a home-made aircraft in 1906, died recently at the age of 75.

* * *

This month saw the 50th anniversary of the B.T.H. Co., which was formed on May 18th, 1896, from an organization developed from the original London firm of Laign, Wharton and Down, who started trading in 1886 as agents for the original Thompson-Houston Electric Co. (Now the G.E.C.) in America.

Wiltshire School of Flying claims to have trained the first post-war woman pupil to fly solo. She is Mrs. Nancy Taylor-Young, a doctor's wife and mother of two children, and she went solo after 9 hours' dual instruction in an Auster.

* * *

The first of 15 Skymasters ordered by Air France was recently delivered to Orly Airport, having flown the 3,700 miles from New York in less than 19 hours. Others are following.

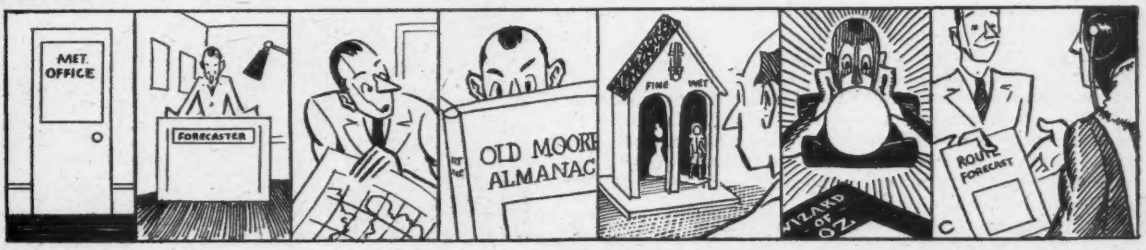
* * *

Many of the 350 civilian passengers on the aircraft carrier, H.M.S. *Fencer*, which sailed from Southampton for Mombasa on May 21st, had been waiting more than a year for transport. The party included 90 Roman Catholic priests from Britain, Holland, and Ireland, on their way to Africa for ten years' missionary work.

* * *

Mr. A. H. Reeves, who was specially commended by the Minister of Aircraft Production as one of the three scientists responsible for the development of the radar device "Oboe," has taken up an important appointment with Standard Telecommunication Laboratories, Ltd., the research subsidiary of Standard Telephones and Cables, Ltd. Mr. Reeves first joined the Standard organization in 1923.

AIRSTRIP . . . . No. 16



(1) The "exposure suit" designed by Sqn. Ldr. E. A. Paske, of the R.A.F. Institute of Aviation Medicine, which packs inside the collar of a "Mae West" and is inflated via a mouthpiece after being donned. It is made of very light airproof material and includes boots and hood as shown. The "breath blanket" keeps out the cold.

Illustrated by "Flight" photographs.

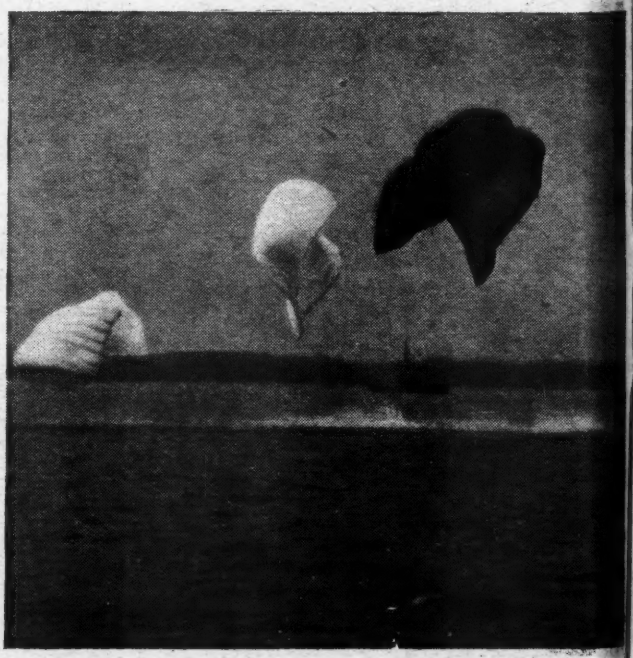
Operation Endurance

Volunteer R.A.F. Crew Tests Airborne Lifeboat MkII and Its Rescue Equipment : New "Exposure Suit" Proves Its Worth in Channel Storm

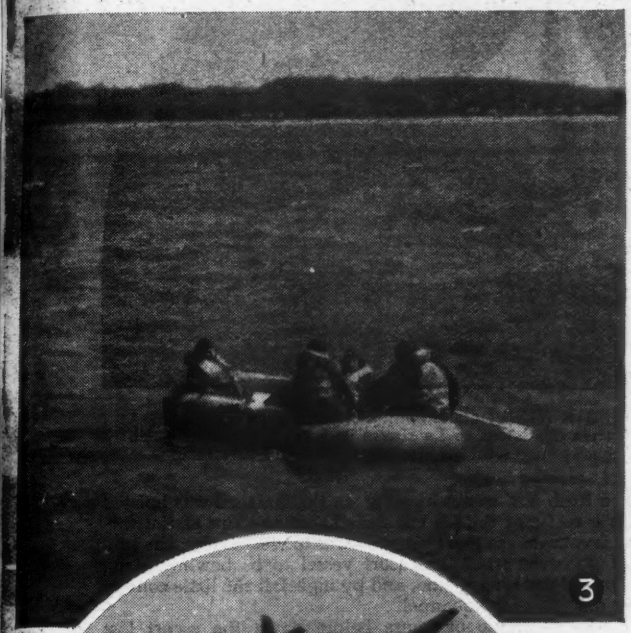
WAR being more concerned with the taking of life than with its preservation, it was perhaps only to be expected that the recently ended struggle should have been well under way before the Air/Sea Rescue Service was formed as a separate organization under Coastal Command, R.A.F. Even then, the urgent needs of the more aggressive branches of the Services meant that Air/Sea Rescue could not immediately enjoy a very high priority either in its supply of equipment or the necessary "brain hours" to develop it. Thus it was that the war was approaching its closing stages before the airborne lifeboat made its appearance in its present form, and before the Service was able to acquire from the Navy its first long-range rescue craft in the form of converted 110ft D-type boats.

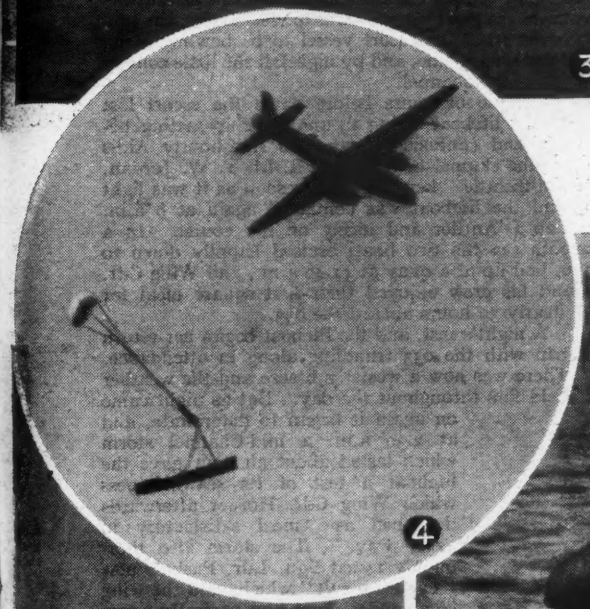
The airborne lifeboat, as carried beneath a Warwick and dropped on a cluster of six parachutes to a ditched aircrew in a rubber dinghy, was first described in *Flight*, January 18th, 1945, but briefly to refresh the reader's memory, it is a 25ft. boat with a plywood hull and is provided both with sails and engine (the Mark I had two small two-stroke engines of the outboard type, but the Mark II is powered by an 8 h.p. Austin marine inboard engine). On reaching the water the parachutes are automatically released and lifelines are fired to port and starboard by rockets operated by immersion switches. A drogue or sea anchor is similarly liberated. The boat is very comprehensively equipped with rations, cigarettes, first-aid kit, signalling and navigating gear, and a manually operated transmitter which sends out the SOS on the international wavelength.

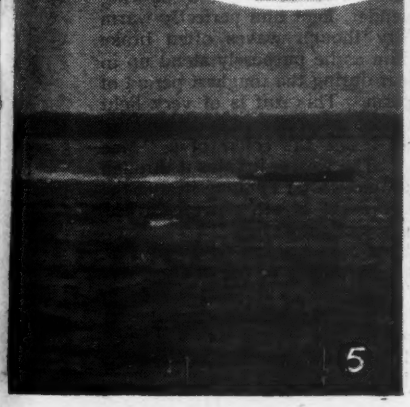
To a bomber crew ditched, for example, well out in the North Sea, the arrival of such a lifeboat was a far grander



(2) In the chill of early morning the five "guinea-pig" volunteers get into their rubber dinghy from an Air/Sea Rescue boat and (3) are turned adrift to begin their five-hour spell of exposure before having the airborne lifeboat dropped to them in the Solent. An unexpected bit of realism was a leak in the dinghy fabric which meant frequent bailing out.







sight than even that of the *Queen Mary* to a G.I. bride, but it was inevitable that operational use of the Mark I should have disclosed a number of ways in which it could be improved upon. The Mark II, therefore, came into being (though not before the end of hostilities) and recently underwent its first serious trial in the open sea.

The trial had a dual purpose—to prove the seaworthiness of the boat itself, and to test the effectiveness of its modified equipment under conditions approximating as closely as possible to the real thing. In the latter respect it was appreciated that equipment which might be perfectly satisfactory when handled by men in normal physical and mental condition, might not be completely effective in the numbed fingers of an aircrew chilled and exhausted by long exposure in a rubber dinghy.

Five Volunteers

Patently the only way to discover any snags under this heading was through the services of volunteer "guinea pigs," and they came forward in the persons of Wing Cdr. T. Q. Horner, Sqn. Ldr. G. W. A. Parker, and Sqn. Ldr. T. C. McNamara, all of the Air Ministry; Sqn. Ldr. E. A. Paske of the R.A.F. Institute of Aviation Medicine; and Sqn. Ldr. A. W. Barwood of the School of Air/Sea Rescue. Incidentally, Sqn. Ldr. Paske had designed a new type of "exposure suit" which was included in the equipment under test.

The trial began when an R.A.F. flying boat tender put out from a Calshot jetty just after 7 o'clock one morning with the five officers and a rubber dinghy aboard. At approximately 7.30 a.m. the tender hove-to where Southampton Water broadens into the Solent, turned the dinghy and its crew adritt, and sprinted back to base and breakfast.

For three hours the dinghy's occupants were left to enjoy the initial experience of a ditched bomber crew. Then at 10.30 a.m. a Warwick V dropped them what is known as Lindholme gear—five containers holding a spare circular rubber dinghy, weatherproof suits, water, concentrated food, cigarettes, and hot-bags. The drop was

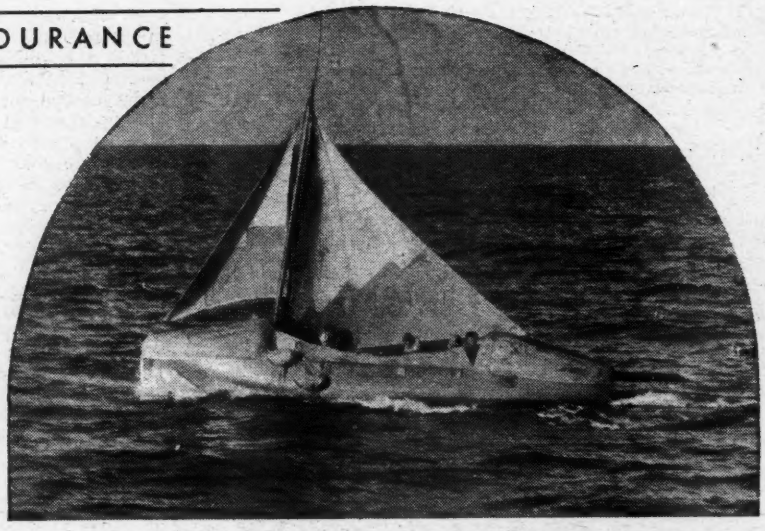
(4) Released from beneath a Warwick V, at about 700 ft., the Airborne Lifeboat, Mark II, lets go its cluster of six parachutes. In the picture the pilot chute is just about to liberate the six main parachutes from the pack. (5) On alighting on the water, the lifeboat automatically casts off its 'chutes and fires rocket lifelines to port and starboard. (6) The drop was reasonably accurate, and it was not long before the dinghy crew had gained the comparatively roomy comfort of the lifeboat to begin the actual sea trial.

OPERATION ENDURANCE

a shade late and the dinghy failed automatically to inflate itself as it should have done. This added an extra bit of realism to the proceedings, especially as the crew's dinghy was leaking through a tear in the bottom fabric and they had been bailing out almost continuously.

At noon the Warwick reappeared and dropped the airborne lifeboat. Once again, things did not go quite according to the text-book (they hardly ever do under operational conditions) but the dinghy crew were soon aboard and, by 12.30 p.m., had their engine running and were heading down the Solent.

It was at this stage of the proceedings that the long-range rescue craft, "033," carrying a small party of Press representatives in addition to its crew, began its duty of escorting the lifeboat on a trip across the English Channel to Le Havre and back again. As already mentioned, the Air/Sea Rescue Service has only lately acquired some of these craft which are powered by four 2,000 h.p. Packard marine engines and have a top speed of over 30 knots. In the words of the 033's genial bos'n, Flt. Sgt. F. Grant, it would have made a lot of difference both to Air/Sea Rescue crews and to the comfort of rescued airmen had these comparatively roomy boats been available early in the war.



(7) FULL SAIL AND A FAIR WIND : and an 8 h.p. engine—enabled the crew to navigate the "Mark II" from the Solent to Le Havre in just under 24 hrs. The return trip was equally successful in spite of a mid-Channel storm.

A Slight Delay

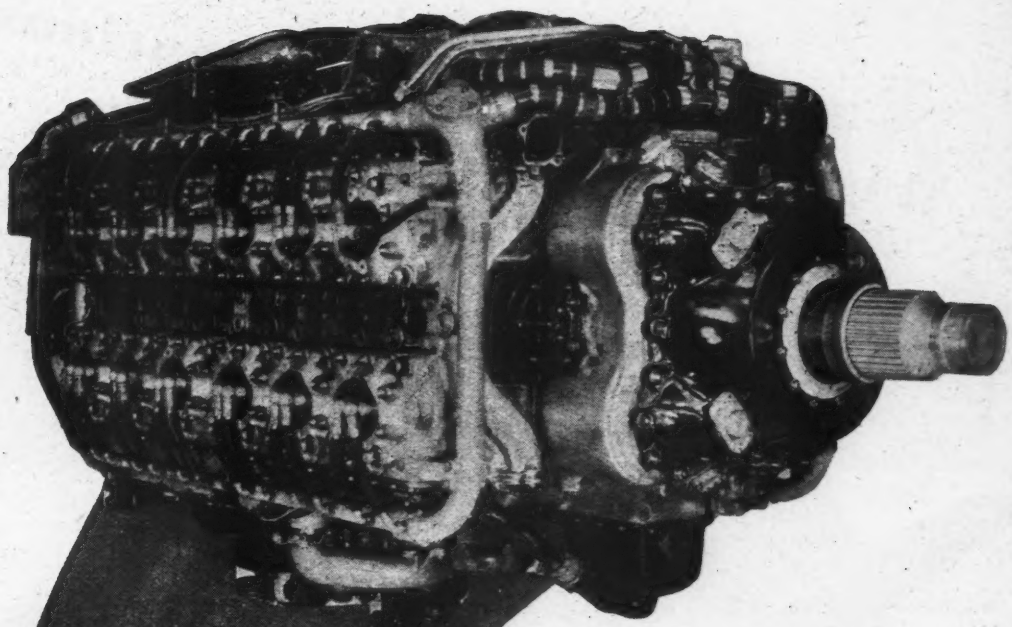
When off Portsmouth, Wing Cdr. Horner, skippering the lifeboat, decided to step the mast and use sail. This operation has been rendered as simple as possible, but it so happened that in this case there had been some error in stowing the rig, so that 1 hr 25 min had elapsed by the time things had been sorted out and the dinghy was again under way. There was a fresh nor'-easter blowing, so the mainsail was hoisted with a reef and the jib left furled, but the run of the tide was favourable so good progress was made. Later, the lifeboat was seen from the escort vessel to be bowling along under full sail plus engine, and by nightfall the little convoy was well into mid-Channel.

About a couple of hours before dawn the escort lost touch with the lifeboat owing to another ship getting between them and confusing the agreed half-hourly Aldis signals, but the skipper of the 033, Flt. Lt. T. W. Jordan, began a full-throttle "key" search as soon as it was light enough, and the lifeboat was contacted again at 8 a.m. just off Cap D'Antifer and nicely on her course. In a dead smooth sea the two boats cruised happily down to Le Havre, tied up at a quay at 11.40 a.m., and Wing Cdr. Horner and his crew enjoyed their first square meal for nearly 30 hours aboard the 033.

A night's rest, and the lifeboat began her return trip with the 033 trundling along in attendance. There was now a westerly breeze and the weather held fine throughout the day. But as night came on again it began to deteriorate, and at 2.30 a.m. a mid-Channel storm which lasted about an hour gave the lifeboat a test of its seaworthiness which Wing Cdr. Horner afterwards described as "most satisfactory in every way." The storm also thoroughly tested Sqn. Ldr. Paske's new "exposure suit" which, said the wing commander, kept him perfectly warm and dry though waves often broke over him as he purposely stood up in the boat during the roughest period of the storm. This suit is of very light waterproof material and is designed to roll up inside the collar of a "Mae West." The wearer inflates it through a mouthpiece after donning it, and the layer of warm breath provides a useful degree of protection.

Calshot was reached at 10.40 a.m. on the fourth day of the trial. "We have found out a number of snags which we could not otherwise have discovered," said Wing Cdr. Horner, "and the trial has been extremely useful."

(8) RESTED AND READY : After "dinner, bed and breakfast" aboard the long-range rescue boat in Le Havre harbour, the lifeboat crew are here seen ready to cast off again for the return trip. At the back are (L. to R.) Sqn. Ldr. A. W. Barwood, Wing Cdr. T. Q. Horner, and Sqn. Ldr. G. W. A. Parker ; and in front, Sqn. Ldr. T. C. McNamara and Sqn. Ldr. E. A. Paske.



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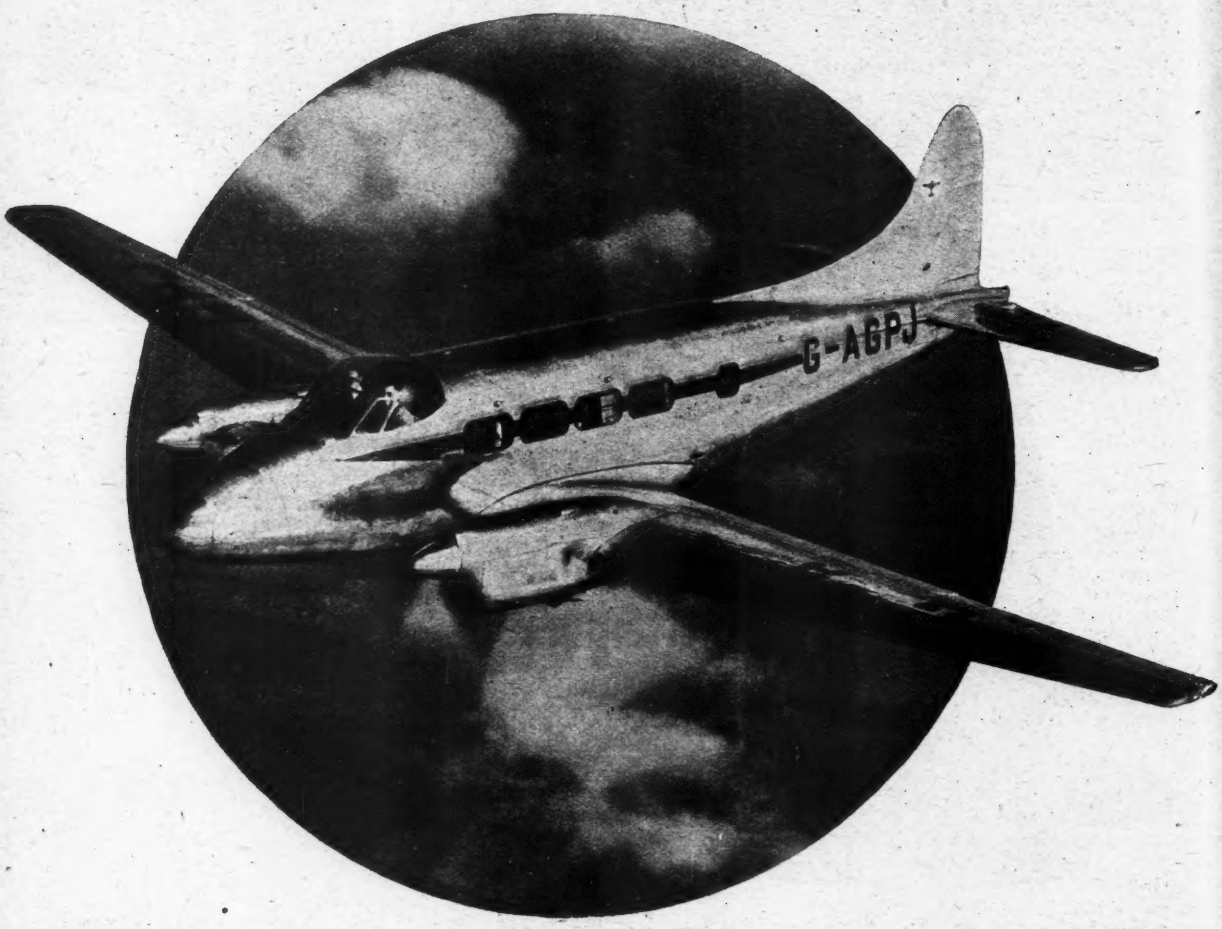

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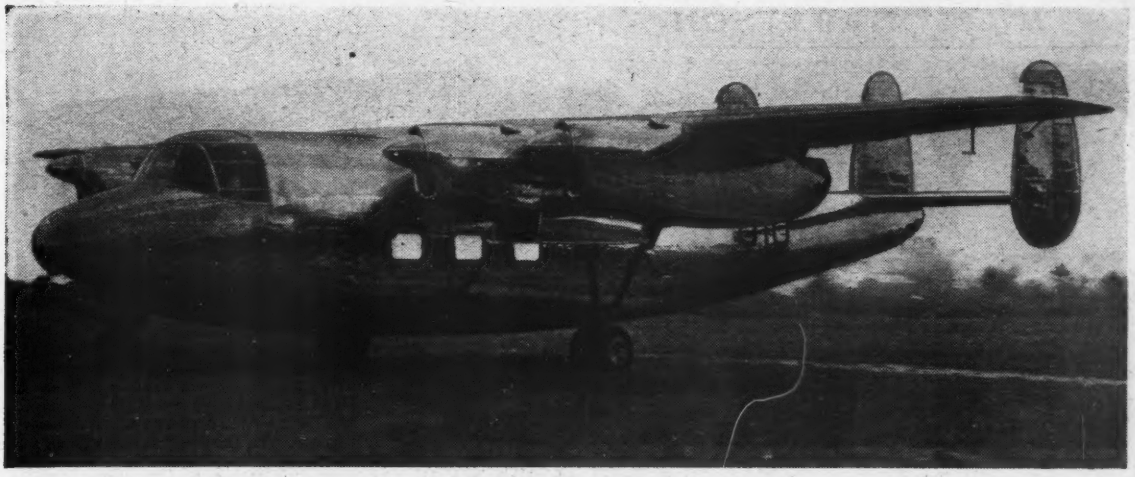


Miles Marathon

Prototype Tests of Brabazon Type Va Under Way : New Medium-sized Medium-range Fourteen-Twenty-seater Transport

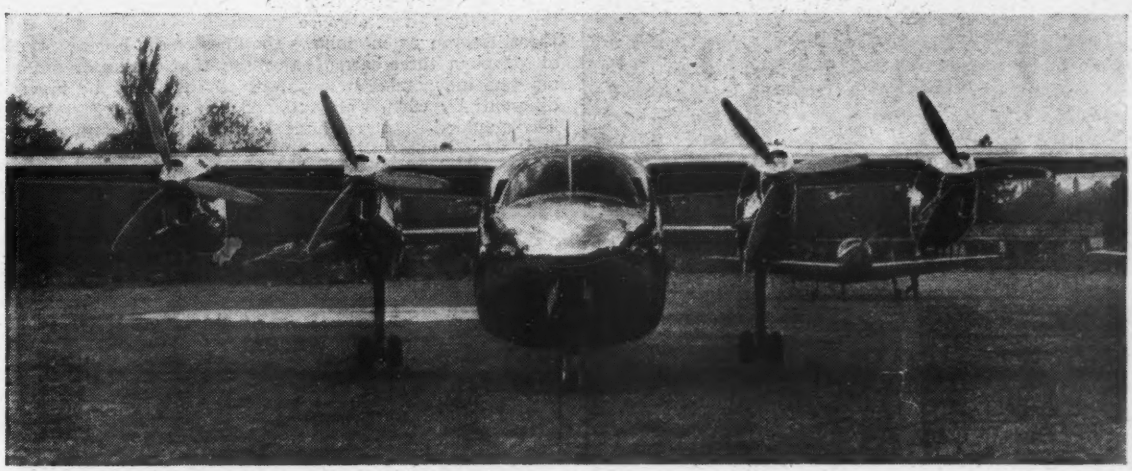
IT has always been customary to announce the result of any initial aircraft test as being "satisfactory" so long as the machine returns safely in one piece. Cryptic initial statements, made here or in America, at least have the advantage of forestalling inconvenient enquiries and of giving the constructors a chance to make those alterations which are almost inevitable when airflow effects are still only partly predictable.

Occasionally, however, there are prototypes which are nearly if not quite right from the start, and the Miles Marathon, which flew for the first time on May 19th from Woodley, seems to be one of them. It is early yet for any outsider to make rash guesses when much development work still remains to be done, but initial flights at medium loading have produced no surprises other than of a pleasant kind.

The Marathon is certainly well up on performance estimates, as the new figures show, and judging from a superficial examination, the only sign of modification lies in the "cording" of the two rudders to counteract any possible over-balance during tests with increasing servo action. At present the Marathon has a central fin in addition to the two outboard.

High Wing

Built to the Brabazon Va specification, the Marathon is an all-metal, high-wing transport fitted in its initial form, with four Gipsy Queen 71s. Those on the first prototype are normally carburated, but all production 71s will have direct injection. It has a tricycle undercarriage, and the standard seating arrangements will be for fourteen or eighteen passengers, with a quick conversion, for short-



An idea of the very practical width of the Marathon's fuselage can be obtained from this frontal view. With a tricycle attitude and the deep screen the range of vision for the crew in all circumstances should be excellent. The main undercarriage legs have twin wheels and, since both these and nose-wheel lower to the rear, there should be no difficulty in the case of any possible power failure

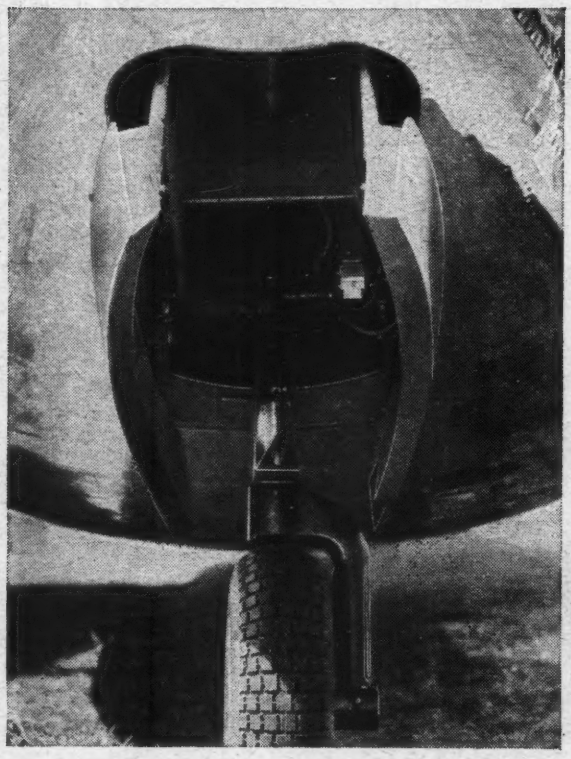
MILES MARATHON

The prototype Marathon has, at least temporarily, grown a central fin. This view shows the conveniently low-loading stance of the aircraft, and the quite uninterrupted upper-wing surface.

range work, to twenty-seater form. Three aircraft are being built to order from the Ministry of Supply, but, so far, there has been no request for series production.

The Marathon might more accurately be described as a *very* high-wing type, since it has been designed so that the main spar and flap-carrying auxiliary spar do not obtrude into the cabin. There is, consequently, quite a pronounced "hump" where the leading edge of the centre section fairs into the fuselage. Since the engines are fully under-slung, there is an entirely uninterrupted upper surface over the whole span.

Both general design and structure are conventional, but there are a number of detail ingenuities to be found. For instance, directional trimming is done through movable fins, and these can also be toed-in during take-off to provide good natural engine-failure control. This arrangement was planned not so much for the four-engined version, but because it is more than possible that later Marathons will be powered with two larger piston engines or by two turbine/airscrew units, and the take-off engine-failure requirements would consequently be more difficult to satisfy. All the trimmers, including the movable fins, are operated electrically from a large multi-position "switch" aft of the main control pedestal. The flaps, which, with the undercarriage, are pneumatically operated, are of the Miles high-lift type. There is a separate emergency system for their operation.



Like the main undercarriage legs, the nosewheel oleo retracts in a forward direction. Maintenance should be simplified by the use of a "one-sided" fork. Both the flaps and the undercarriage of the Marathon are pneumatically operated.

As might be expected with such a layout and with the large-diameter fuselage, the Marathon has quite unusual passenger and freight capacity. The depth of the passenger compartment averages 6ft 2in, with a total capacity of 774 cu. ft., while the forward and aft luggage freight compartments have capacities of 104 and 164 cu. ft. respectively. There are exterior doors for each of these holds, while both these and the main cabin door are at a conveniently low level.

Since the aircraft is a medium to short-range transport type, the control cabin is arranged normally for a crew of two, though space is available for a third crew member. The starboard dual controls can be quickly removed. All the ancillary controls are mounted centrally and the throttle arrangement follows the lines of the Fortress type of "broken three-barred gate," so that inners or outers may be independently open, or all four may be moved differentially when the combined central "bar" is held. The moulded quarter-spherical screen is very amply deep and, with bad-weather windows on each side and a tricycle undercarriage, the view in all conditions should be excellent.

MILES MARATHON. FOUR D.H. GIPSY QUEEN 71 ENGINES

DIMENSIONS

Span	65ft.
Length	52ft 1in.
Height	13ft 9in.

WEIGHTS

Tare weight (Passenger version)	11,200lb.
" " (Freighter version)	10,260lb.
Payload (500 miles range)	3,600lb.
" (1,000 miles range)	2,725lb.
" (freighter 500 miles range)	4,540lb.
All-up weight	16,240lb.

PERFORMANCE

Maximum still-air range	1,000 miles.
Maximum continuous cruising speed (6,300ft.)	230 m.p.h.
Economical cruising speed (10,000ft.)	175 m.p.h.
Distance to clear 50ft. at full load	500 yd.
Initial rate of climb	1,550ft/min.
" " " (3 engines)	950ft/min.
Service ceiling	24,000ft.

DE HAVILLAND DOVE

Modernity in Miniature: All Metal Transport for Eight to Eleven Passengers: Gipsy Queen 71s with Direct Injection

IN all the talk about the merits and international saleability of bigger and better civil aircraft, the commercial value of small-size transports appears to have been very largely forgotten. Yet, throughout the globe, there will always be a useful market for aircraft intended for tributary routes.

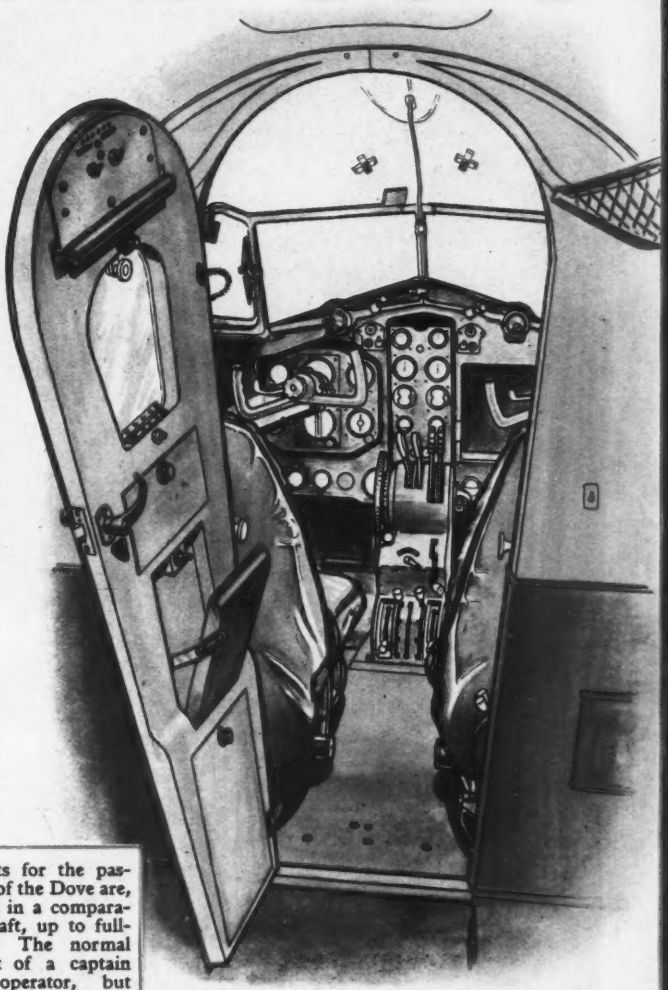
Obviously, the evolution of such a miniature transport, if it is to be designed to modern standards, can be by no means the simple matter which it might at first seem to be. In the first place—and since ancillary equipment has more or less the same weight whether this is installed in large or small aircraft—the designer is, unless ingenious, liable to be at a disadvantage when planning his payload. Secondly, a good single-engined performance is less easy to provide in any low-powered twin than it is, for instance, in a larger transport aircraft.

Utilisation Compromise

Further, the present-day operator will demand from his fleet the ability to maintain a high rate of utilisation, yet, when opening new routes or running charter services, he will hope for sufficiently low operating costs to make low utilisation economically reasonable. Finally, an operator is likely also to demand metal construction in an aircraft which is to be given intensive use over a number of years, and this feature might, without very careful design, be expected to involve penalties in both weight and cost.

So, in the face of these problems, the fact that the designer of the D.H. Dove has succeeded in producing an aircraft with a good performance and load-carrying capacity, a safe engine-failure performance and good maintenance features is something of an achievement. And these have not been made possible at the expense of "modernity" which is essential in any civil aircraft intended for future as well as present markets. The Dove is no stop-gap. It has been developed, as the "Brabazon 5b," to fill all the requirements likely in its class during the coming few years, and to remain up-to-date unless and until very considerable changes in aircraft and power-unit design can be usefully and economically incorporated in small civil aircraft.

Nor can the Dove be considered merely a "Rapide replacement."



The arrangements for the passengers and crew of the Dove are, as far as possible in a comparatively small aircraft, up to full-scale standards. The normal crew will consist of a captain and a radio operator, but quickly removable dual control is provided.

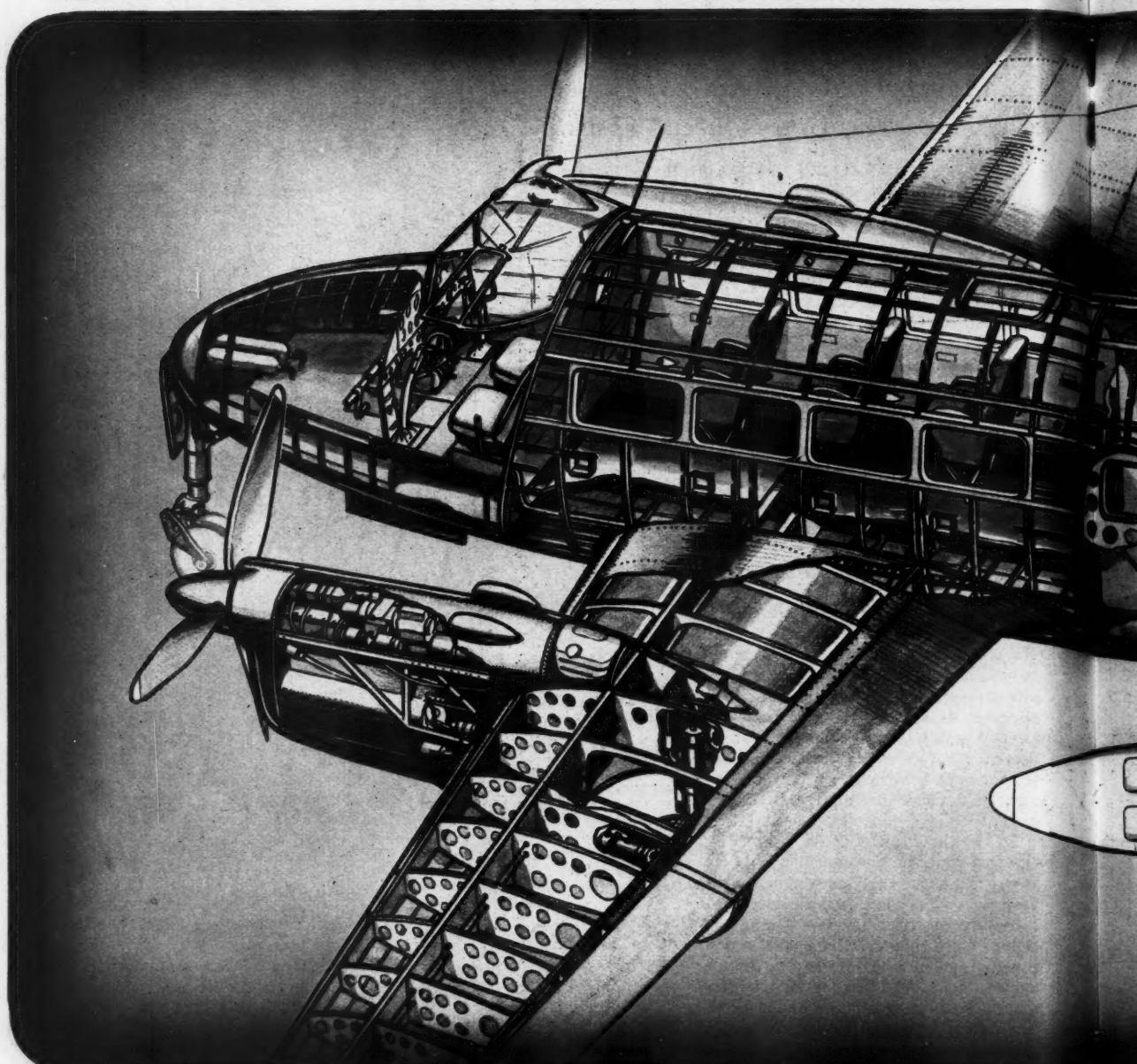
Although its uses will to some extent overlap those for which the Rapide was originally developed, it is also intended to fill a somewhat different and more "civilised" market in which a much higher degree of utilisation is to be expected. Whereas the Rapide, or any similar type will—at least until the regulations kill it—always have its value in cases where operators are working with light or varying traffic in "pioneer" conditions, the Dove is intended primarily for present or prospective feeder-line services on which an annual utilisation figure of as much as 3,000 hours can be expected with loadings of not less than half capacity.

Efficiency

In fact, the minimum annual hourage for economical use of the Dove will be about 800-1,000, while the Rapide can, of course, work with rather lower utilisation. In an earlier article (*Flight* of October 11th last

FLIGHT

DE HAVILLAND DOVE . . . . . .

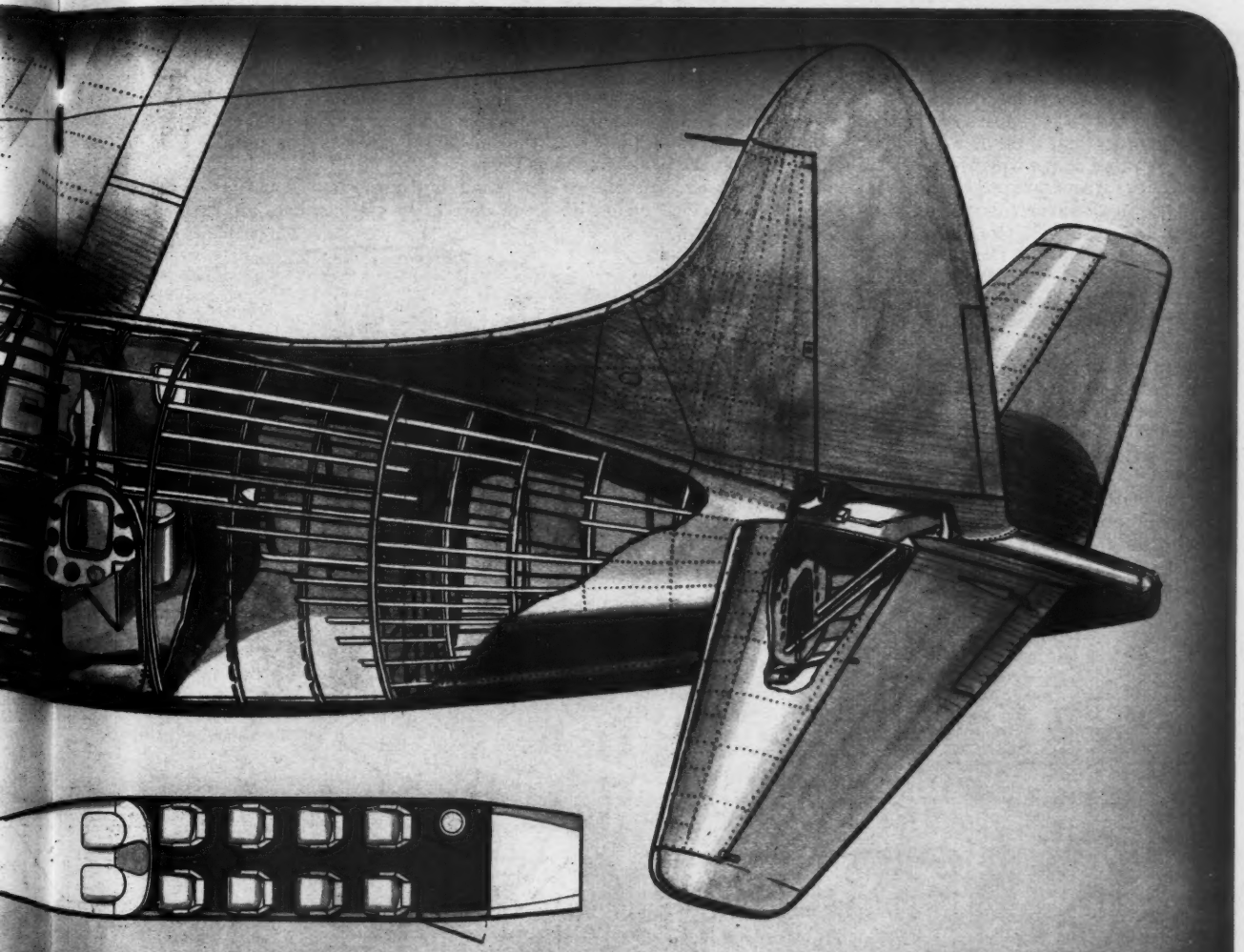


year) the various economic considerations were explained and some comparisons made between the two types with the help of a series of graphs. Although some slight changes will necessarily have been made in the basic figures, following the increase in all-up weight and payload of the production Dove, we do not propose in this article to cover the same ground again, but to deal with other aspects. It will be enough to say that the Dove carries nearly six ton-miles of payload for every gallon of fuel used—a figure surpassed only, at least in D.H. history, by the 1938 Albatross.

Naturally enough, in working out the details of an aircraft of this type, very special attention has had to be paid to the various points which make for ease of maintenance and the aircraft's consequent ability to put in payworthy hourage figures in the course of operation. As a matter of interest the minimum figure of 800 hours per year which the manufacturers consider to be the lowest at which the Dove can be economically operated is equivalent to a day-to-day use at the rate of only 2.2 hours in every twenty-four. Modern ideas in airline operation suggest that something in the region of 10 hours at half-load is a not unreasonable expectation, so economically the Dove should have a good deal in hand.

Before dealing with the structural and accommodation details, therefore, it might be as well to describe the more outstanding maintenance features, since

FEEDER-LINE TRANSPORT ON MODERN LINES



THE simplicity of the Dove's structure may be gathered from a study of this colour drawing. The aircraft is shown here in its standard eight-seater form. When intended for shorter runs bulkheads can be removed to provide accommodation for nine or eleven passengers.

these are likely to be of special interest to all prospective operators.

For instance, as power units must eventually be overhauled and are, by their very nature, somewhat less continuously reliable than any "plain" structures, the fact that these are arranged so as to be quickly replaceable and interchangeable is a matter of primary interest.

Each engine, complete with its welded steel mountings, fireproof bulkhead, oil tank, oil-cooler and all accessories, is carried on four quick-release pick-up points. The majority of the controls and pipelines run through the inboard leading edge, where they are grouped at a break-down panel so that they can be disconnected and re-connected without difficulty. The engine controls have quick-release connections which leave the adjustment unaffected. At this point there are also connections for the airscrew de-icing pipe; boost, priming and air pressure lines; airscrew controls; vacuum pipe; cut-out and filter controls; and air intake.

GROSS WING AREA: 335 SQ. FT

Break-Down Grouping

At the firewall the ignition, thermo-couple, starter, fire extinguisher and generator leads, as well as the cabin heater and fuel filter, are disconnected. To reach the break-down panel the two halves of the inboard leading edges are hinged from points along the false spar.

Because any serious mishap to the aircraft might involve subsequent transportation, the Dove has been designed with each wing

LENGTH: 39 FT. 4 IN.

DE HAVILLAND DOVE

detachable at the fuselage, thus reducing overall transport width. At this point there are quick-break points for pipelines, electric services and control cables. In addition to the usual wing inspection panels, the leading edge may be detached to permit inspection back to the main spar and in order that the T.K.S. de-icing distributors may be incorporated at the will of the purchaser and without the necessity for separate production arrangements. Provision is made in all aircraft for the de-icing pipe runs and the electrical wiring.

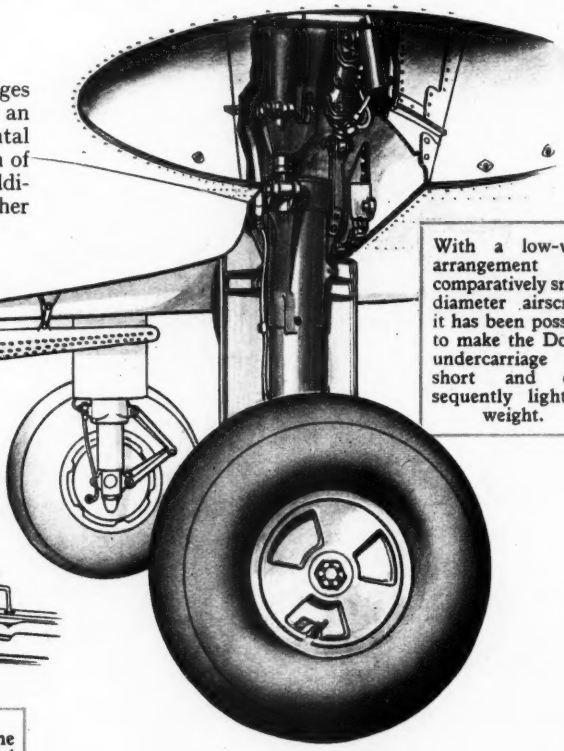
Accessibility

Apart from the more normally considered advantages of a tricycle arrangement, the necessity for providing an adequate wheelbase has brought several incidental virtues. For stowage every advantage has been taken of the fuselage length ahead of the control cabin. In addition to the luggage locker under the cockpit, three other compartments can easily be reached from ground level.

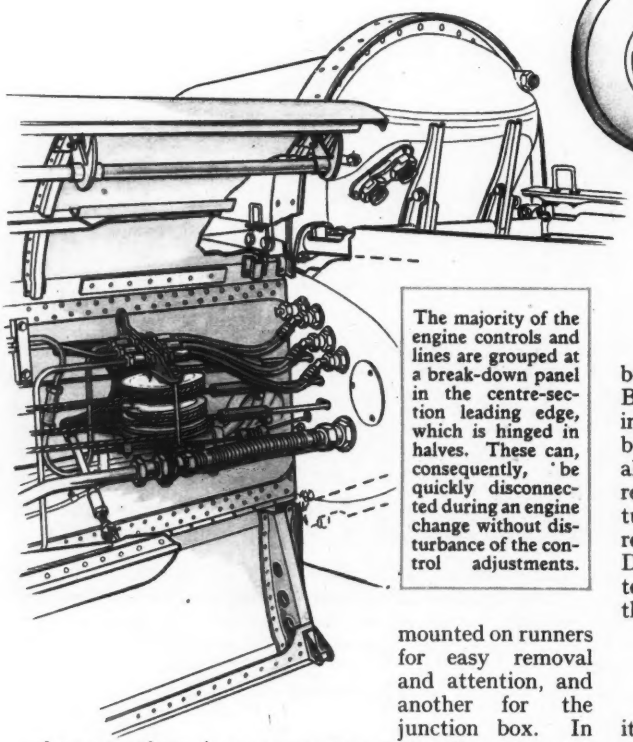
Forward of the screen the deck fairing can be hinged upwards for access to the radio equipment, the rear of the dashboard, the controls and sundry ancillary services. On the starboard side there is a compartment for the battery, which is mounted on runners for easy removal and attention, and another for the junction box. In the nose there is a compartment for the pneumatic items and reservoirs, which can be reached through a hinged door. In the luggage compartment below the control cabin the various interior panels are quickly detachable in order that the control cables and the various electric and pneumatic lines can be reached for any necessary attention.

There is a set of inspection doors below the fuselage for reaching the elevator and rudder control cables, so there will be no need for the cabin floor to be disturbed. The interior of the tail part of the fuselage can be reached through a door in the rear luggage locker bulkhead and the tail cone is toggle-fastened so as to be quickly removable. The rudder and elevator can be changed without disturbing the adjustment of the operating cables. Amongst the items which are interchangeable—so reducing the number of spare parts to be carried by an operator—are the two elevators with their trim tabs, the respective port and starboard tanks, and a number of the incidental parts of the nose and main undercarriages.

One of the small but important war-time developments has been that of special cements for both wood bonding to metal and metal-to-metal joints. The de Bruyne Redux process is used to a considerable extent in the Dove for the attachment of stringers to the skin both in the wings and the fuselage, and spot welding is also used where possible. Thus, in each case, there is a reduction of the number of rivets required in the structure, and both weight and skin friction are thereby reduced, while rather lighter gauge material can be used. During the assembly of the machine the surface is protected by a cellulose skin; this is sprayed on and, when the aircraft is ready for test, can be quickly peeled off.



With a low-wing arrangement and comparatively small-diameter airscrews it has been possible to make the Dove's undercarriage legs short and consequently light in weight.



The majority of the engine controls and lines are grouped at a break-down panel in the centre-section leading edge, which is hinged in halves. These can, consequently, be quickly disconnected during an engine change without disturbance of the control adjustments.

Sub-Assemblies

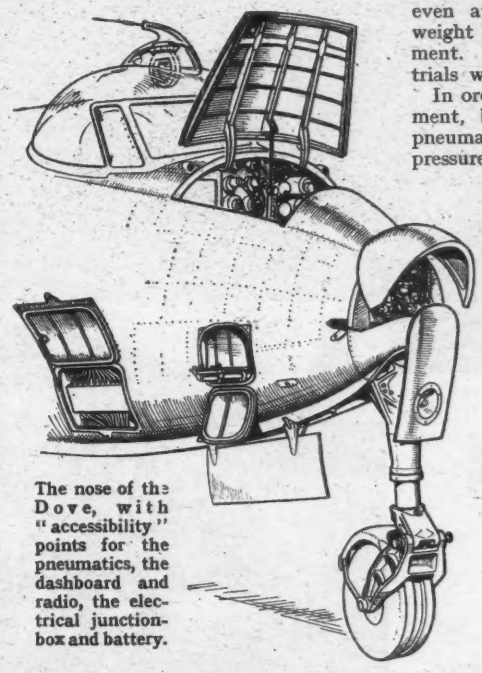
Although of "continuous" construction throughout its length, the fuselage is actually made in three parts and these three are further sub-divided, in Mosquito production fashion, for ease of manufacture. The main section, from the structural bulkhead aft of the control cabin to the rear luggage bulkhead, is jigged in four longitudinal sections, comprising the roof, the two sides and the floor, each of which can be partly upholstered and equipped before the four are riveted together. In this central section of the fuselage there are double curvatures only in the portion aft of the passenger bulkhead, where the section is starting to taper off towards the tail. The

nose and tail portions of the fuselage are each jigged in halves.

The fuselage is of monocoque construction, with alclad skin reinforced with hoops and stringers of V-section sheet. Apart from the six main "longerons," two above and one below the windows on either side, the majority of the stringers are Reduxed or spot-welded in position. The bottom section of the fuselage carries the single centre-section spar from which the wings are picked up, with a continuation of two false spars; only the spar proper is above floor level. This floor structure is designed to carry concentrated freight loads and is covered with a two-piece sandwich flooring of light alloy and plastics.

The cabin entrance door is on the port side, and there are two emergency exits in the roof. Since the fuselage walls are amply stiffened by the longerons, the windows can be large. The roof of the control cabin is of perspex, moulded with an upward extension, in the shape of a fireman's helmet, to carry the fixed aerial and to enclose the D/F loop.

Built up around an I-section member, the wings carry a false spar at the rear to take flap and aileron loads, and, to a point outboard of the engine nacelle, another false spar to which the engine bearers are attached. The ribs are simple diaphragm pressings and there are span-wise skin stiffening stringers. The leading edges and wing tips are detachable.



The nose of the Dove, with "accessibility" points for the pneumatics, the dashboard and radio, the electrical junction-box and battery.

All the control surfaces, including the "plain" flaps, are fabric-covered. The latter move to a maximum 60-degree "down" position, with an intermediate setting at 20 degrees for normal approach use and for taking off from restricted areas.

In its prototype form the Dove had geared-servo elevator tabs, but these were found to be unnecessary, though an elevator balance-weight system was introduced to damp out a tendency to slow-phase instability on the climb. The adjustable tab on the rudder is, however, of the servo type, with very low gearing. There is no flight adjustment for lateral trim, though there is a movable tab for any necessary ground setting.

During early test flights it was found advisable to increase the area of the dorsal fin in order to improve the very low-speed single-engined control. Apparently the Dove could, from the very start, satisfy the somewhat rigorous control and rate-of-climb "asymmetric" requirements. The regulations concerned are particularly difficult where low-powered twins are concerned, and the fact that the Dove can compete with these, even at more than the original all-up weight figure, is something of an achievement. Incidentally, all the engine-failure trials were made at take-off level.

In order to simplify the ancillary equipment, both undercarriage and flaps are pneumatically operated from a Hymatic pressure system fed by duplicated engine pumps and reservoirs. This duplication permits the services to be operated normally in the event of one engine or pump-drive failure, while there is, in addition, an air bottle for emergency undercarriage lowering.

Simple Undercarriage

Apart from the fact that it is pneumatically operated, the Dove's undercarriage action is very similar to that of the Vampire, with the radius rod in two parts and mechanical swinging-link locks to hold the legs in the "up" and "down" positions. A Marstrand double-track anti-shimmy tyre is fitted to the nose-wheel, which is castoring and self-centring. The relatively small diameter of the aircrews permitted the use of short legs and, in fact, the cost in extra weight of the tricycle has proved to be very small.

The four tanks in the fuel system are mounted in bays inboard of the power units, those in front of the main spar having a capacity of 26 gallons each and those aft carrying 39 gallons each. The pairs on each side are interconnected so that there is only one filler cap and fuel feed on each side and need for only two contents gauges.

With the use of direct injection for the Gipsy Queen 71 geared and supercharged engines the intakes are in the leading edge on the port side of the engines and can be controlled to provide "ram" entry or filtered air at will. No heated air control is required since the butterfly and intake elbow are oil-heated.

Although the standard Dove has, with full tanks, a still-air range of nearly 1,000 miles, it is intended mainly for work over non-stop stages of about 300 miles. For such runs the seating arrangement can be varied to give accommodation for eight, nine or eleven passengers.

With the normal arrangement there are four forward-facing seats on each side of the centre gangway with, behind them, a toilet compartment and, behind that, a luggage hold. The door in the cabin bulkhead swings rearwards when opened to form a "wall" to seal off the toilet compartment when passengers are entering or leaving.

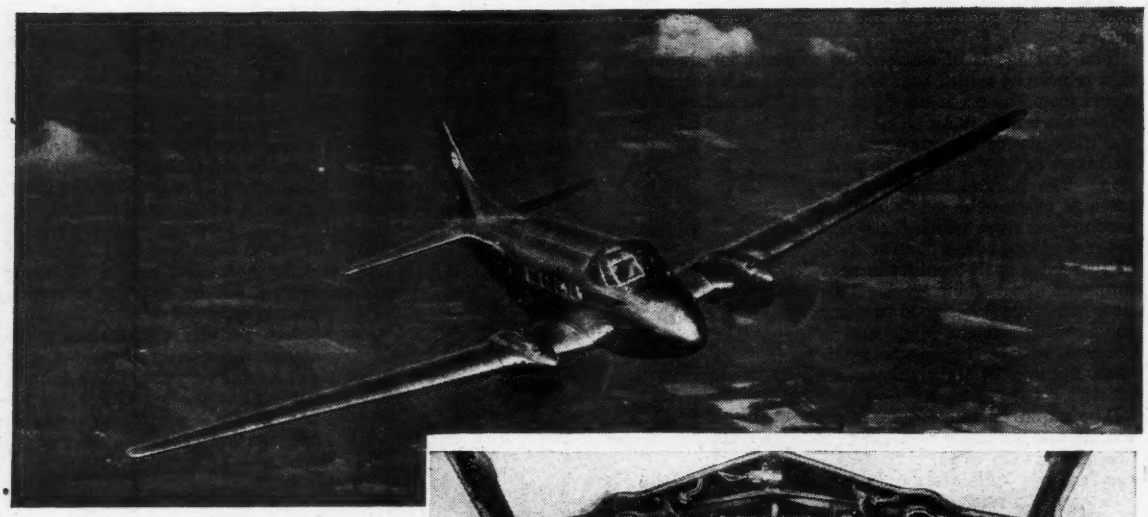
This eight-seater version may be converted to carry nine passengers if the cabin bulkhead is removed and an extra chair installed in the toilet space opposite the entrance door. For still shorter runs the bulkhead aft of the entrance door and toilet can also be removed, and the luggage locker wall moved back some fourteen inches, thus leaving room for two more seats. Both these conversions can be made by the operator. The cabin is, as a matter of interest, 6 inches wider and higher throughout its length than that of the Rapide at its largest section.

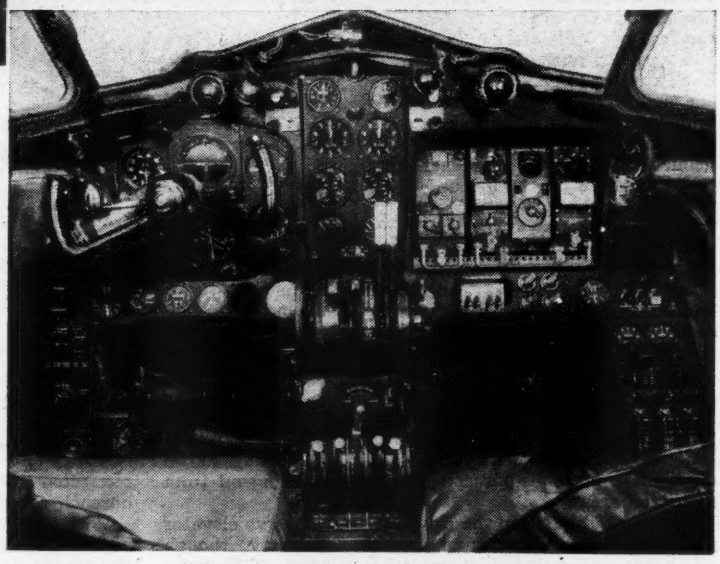
A supply of hot air, which is controlled by the crew, is ducted along the length of the cabin at floor level and enters it through eight grilles. When necessary in tropical conditions cold air can also be directed through ducts.

D. H. DOVE

	lb	Kg
Weights (Standard 8-Seater)		
Tare weight (including 8 chairs, toilet and standard Marconi radio)	5,625	2,556
Crew of two	340	154
Fuel, 79 gals (359 litres) for 500 miles (805 Km) still-air range and usual allowances	577	262
Oil, 10 gals (45.5 litres)	90	41
Payload	1,868	847
All-up weight	8,500	3,860
Performance (A.U.W. 8,500lb. and standard conditions)		
Maximum speed (5,800ft. ; 1,770 m.)	222 m.p.h.	357 km/hr
Continuous cruising speed (0.5 take-off power at 5,000ft., 1,525 m)	155 m.p.h.	249 km/hr
Fuel consumption	22 gal/hr (7.05 ml/gal.	100 litre/hr 2.49 km/litre)
Maximum weak-mixture cruising speed (8,500ft., 2,590 m.)	200 m.p.h.	322 km/hr
Fuel consumption	34 gal/hr (5.9 ml/gal	155 litre/hr 2.08 km/litre)
Climb (normal climb power at sea level)	750 ft/min	229 m/min
Service ceiling	18,500ft.	5,650 metres
Time to 5,000ft. (1,525 metres)	6.5 min	
Time to 10,000ft. (3,050 metres)	12.9 min	
Distance to clear 50ft (15.3 m) in still-air at sea level (runway), flaps 20 deg., at safety speed	770 yd	703 metres
Distance to rest from a height of 50ft (15.3 m), in still air at sea level (flaps 60 deg.)	750 yd	685 metres
Rate of climb at sea level on one engine	230 ft/min	70 m/min

An exclusive description of the handling qualities of the Dove appears overleaf.





Flying the Dove

Easy Handling Characteristics and Simple "Drill" : Making the Best of Both Worlds

By H. A. TAYLOR

All "flying" controls in the Dove are grouped in a central pedestal. The engine instruments are in the dashboard centre, and the blind-flying panel is on the left. The control columns curve over from the sides, so that the seats are easily reached. In this picture the starboard controls have been removed.

AFTER nearly six years of more or less daily battle with over-powered and sometimes even faintly lethal military types, it might be considered to be a little difficult to approach a genuine civil aircraft with a perfectly clear judgment. Too much or too little might be expected, and one might even tend to pass happily over characteristics which, in a transport aircraft, are not all that they should be. However, the fact that in the eight months previous to my experience of flying the D.H. Dove I had driven little more troublesome than a few light aircraft should help to balance the situation.

Certainly, and apart from any slight if inevitable "hamness" in my initial take-off and landing, I found no difficulties at all—and this should, for a start, be a very fair recommendation. For, although the Dove is in the light transport class, it is by no means merely a "grown-up light aircraft," but has both the controls and the better mannerisms of the modern full-size transport. In other words, although any reasonably competent pilot of the old-fashioned kind would have little or no trouble with its handling, he would still need to learn something of the latter-day "drill" and of the flying features which can be expected in modern types.

It might be as well, by way of an introduction, when dealing with the Dove from the flying point of view, to go through this "drill." Since all the flying essentials are grouped together in a central control pedestal this can comfortably be carried out either mnemonically or visually, and all action, other than that involved in merely flying the aircraft, is taken with the right hand only. Using the ageless C.F.S. system covered by the letters HUMPFG, only the first mnemonic letter might cause the entire stranger a moment of anguished search. In this case "H" stands for pneumatics, and for this, rather after the fashion of some earlier types, there is a master control which is turned off when the aircraft is parked so as to remove the possibilities of pressure loss. The fore and aft trimming wheel is on the left of the pedestal, while the directional trimmer is a small crank on its rearward face; both are set at neutral for take-off. The mixture is automatic, so we can move on to "P" for propellers—set against the reverse pitch stop for 2,800 r.p.m., the maximum revolutions of the Gipsy Queen 71.

Simple Fuel System

The fuel cocks, one for each engine, are at the base of the pedestal on either side of the two cooling flap controls. Each cock has three positions—"off," "on" and "cross-feed," whereby the starboard engine can be fed from the port tanks, or vice-versa. In temperate climates, at least, the cooling flaps can be left closed except during long-period ground runs but various settings are provided. The flap control is on the right of the rear of the pedestal to match the undercarriage control on the left, but it is a

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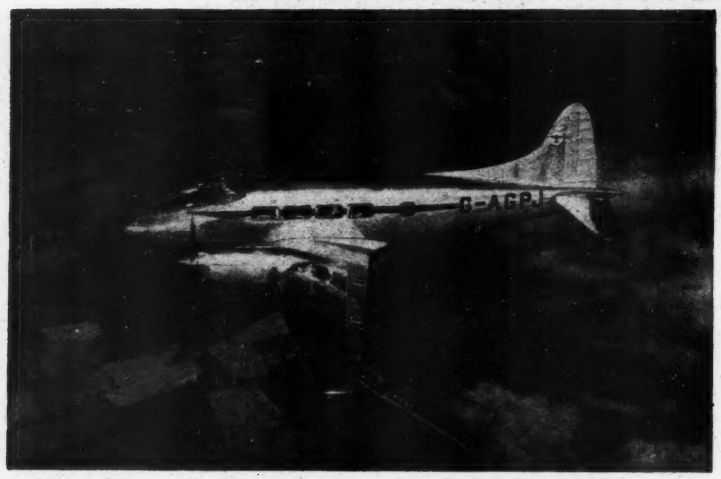

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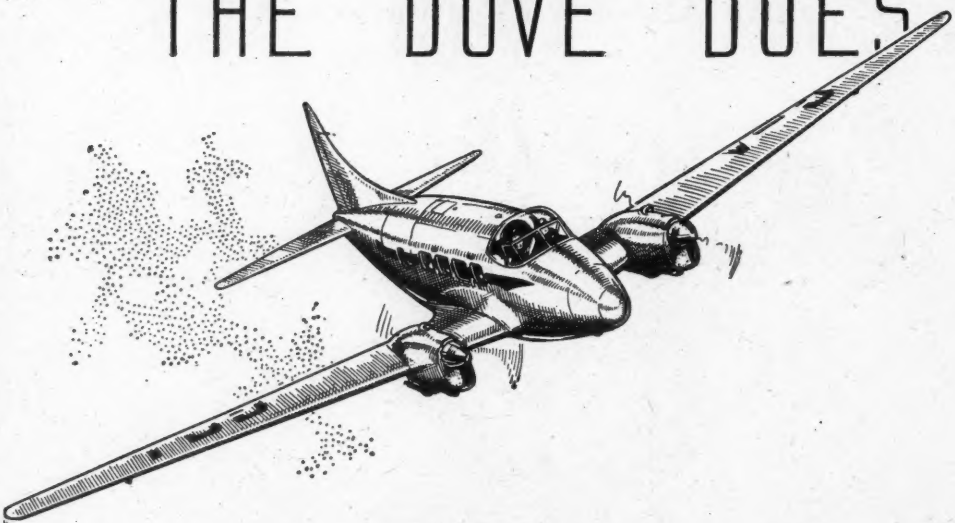
THE DOVE DOES IT!



The De Havilland Dove has just passed all its trials with flying colours. It now becomes our first-line, feeder-line Transport Aircraft. As is natural only the finest materials were embodied in its construction—that's why NEO-K-TEX was used throughout. For NEO-K-TEX is unsurpassed for all Oil and Petrol-resisting Jointings, Packings and Mouldings. In fact anywhere when first-class jointing is required.

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gated lever, whereas the undercarriage selector is of an unusual plunger type with a press-button safety catch. The two cannot, therefore, possibly be mixed up during any after-dark or bad-weather fumblings.

The combination of a directionally stable tricycle and the British type of thumb-operated brake lever with the usual differential rudder control makes, I consider, the best of both. In fact, during the course of ordinary manœuvres, there is no demand at all for extravagant braking control—the trigger needs to be used only to keep the speed down. The fully castering nosewheel turns easily, but not too easily, under differential throttle alone, yet it runs true, even over rough ground, unless forced out of the straight. Since one can see almost a complete forward hemisphere as well as the wing tips, the Dove offers neither difficulty nor danger during ground movements.

FLYING THE DOVE (CONTINUED)

Thanks largely to the "lap" position of the control half-spectacles, to the fact that the engine controls can be held without effort, and to the instantaneous adjustment of the rudder pedals more or less in Mosquito fashion, the pilot who is new to the type should immediately feel at home. In an aircraft which must be sold on merit to an airline company's pilots as well as to its directors, this is a more important point than the mere words imply. One can become accustomed almost to anything after a few hours' experience, but the demonstratee is not likely to have a chance of spending that amount of time in the Dove's driving seat. The aircraft feels right from the start.

On the take-off, the Dove shows (though I never noticed it) a very slight tendency to swing to starboard, but if this, or any deviation due to other cause, is corrected on the throttles in the first fifty yards, any further correction can be made on the rudder, and the throttles can be moved quickly and together to the plus 6 maximum boost position—at which the acceleration is equal to that of most military types. When trimmed at neutral it is necessary to lift the Dove off, whether using the take-off flap setting or not, but, if it is being flown from a grass surface of doubtful quality, one can lift the nosewheel during the first part of the run and let the aircraft fly off tail-down. In the prototype the throttles are rather too close together for comfortable "weaving" action, but they have been splayed out in the production aircraft.

Climbs

At +3 lb and 2,600 r.p.m. the best climbing speed is 115 m.p.h., but the Dove feels more natural at 125 m.p.h., and this is probably the best speed from the point of view of passenger comfort. In the "book" a rate of climb of 750ft/min is given, but the impression during the first thousand feet or two is that of a much higher figure—possibly some "psycho" effect of attitude, sound and control feel generally. With the particular loading at the time, there seemed, at the lower climbing speeds, to be a slight tendency to very slow-phase instability. In all other conditions the Dove appears to be quite naturally stable, though the prevailing conditions prevented any long-period check.

A.R.B. regulations rightly demand that transport aircraft should be able to continue flying with the undercarriage still down after engine failure and at 1.1 times the stalling speed. As most people know, the primary difficulty is not that of merely remaining in the air and of continuing to climb, but of maintaining directional control. No attempt was made to imitate these conditions, but the starboard throttle was cut back on take-off as soon as the undercarriage was up and at an airspeed of 110 m.p.h. or less; the incipient swing was held very comfortably and unconsciously on the rudder, and the climb continued, without feathering or immediate retrimming.

In level flight and with the throttled engine's airscrew feathered, the Dove seems to maintain height at 120 m.p.h. and at a "good" engine boost as low as zero. For feet-off flying in this condition only about a third of the rudder-trim range is needed and the aircraft turns comfortably and without undue control correction in either direction. The feathering procedure is slightly different from that usually associated with D.H. airscrews. In the airscrew control gates there are cam stops at the minimum r.p.m. position. When feathering, the c.s. lever is brought back through the gate and the button pressed; the action is completed almost as soon as there is time to glance at the airscrew. When unfeathering the control is moved first up to the gate, the feathering button held until 1,500 r.p.m. are shown, and the control then advanced at a rate depending on cylinder-head temperature.

With any normal elevator action, the Dove's stalling characteristics, with undercarriage and flaps either up or down, could hardly be more innocuous. In each case the aircraft just sits with the nose alternately rising and falling. Loaded as we were, the indicated stall, with flaps and undercarriage down, was in the region of 70 m.p.h., but this was not very easy to define since the stall is accompanied by sharp fluctuations of the A.S.I. and some undisturbing shudderings from the rear.

At cruising speed—155-160 m.p.h. at zero and 2,000 r.p.m.—it is possible to talk normally even in the control cabin. In the passengers' department the Dove is certainly as quiet as any other present-day transport. Even at take-off and climbing revolutions there was no need to raise the voice, and there is no sign of vibration or drumming. It might, however, be a good thing to reduce the slight "bump" caused by the undercarriage action, since this might give any nervous passengers cause for momentary heart-stoppage.

Arrivals

Approaches and landings were made at three airfields—one of rough grass and out of wind; one with a single runway out of wind; and one with the conditions more or less right. No difficulties were experienced during any of them. The Dove can be held off almost to a "reversed" three-point attitude and it is perfectly stable in all axes in the near-stalled condition. When put down stalled the nose afterwards sinks forward gently. In due course braking airscrews will be fitted for use in difficult conditions, but, except for a likely reduction in insurance premiums, this braking capacity should rarely be needed. When airscrew-braking the controls are moved forward past a quickly movable stop, and the throttles then opened if additional braking thrust is required. There is no difficulty, apparently, about learning the throttle-moving technique involved.

Normally one uses the 20-degree flap position for both approach and landing, but a very much shorter arrival can be made by applying the full 60 degrees during the final stages. The drag, in this case, is quite considerable, and it might be a good thing to institute an intermediate flap position for standard conditions. The "float" at the take-off setting is a shade marked, yet the drag at the present maximum setting is rather too great and considerable power would be necessary to recover from any serious under-shooting. The flap action produces a very slight nose-up effect. Incidentally, I found that very little of the fore and aft trimming range needed to be used, and the Dove could be held off properly even when it was brought in with the trimmer at a nose-heavy position.

No tendency to deviate from the straight in a cross-wind was noticed, and brake was needed only at the end of the run. Just the right "balance" of castering action in the nosewheel seems to have been found; the Dove goes straight when unchecked, yet shows no disinclination to turn. We seem to have learnt a great deal about nosewheels in the last few years.

There are quite a number of points of interest which cannot be described in the space left on this page. But I will mention one. The direct-vision windows are big, let in no rain and only a fair amount of air; furthermore, they really can be opened "parked" and closed again naturally and while using one hand.

CIVIL AVIATION

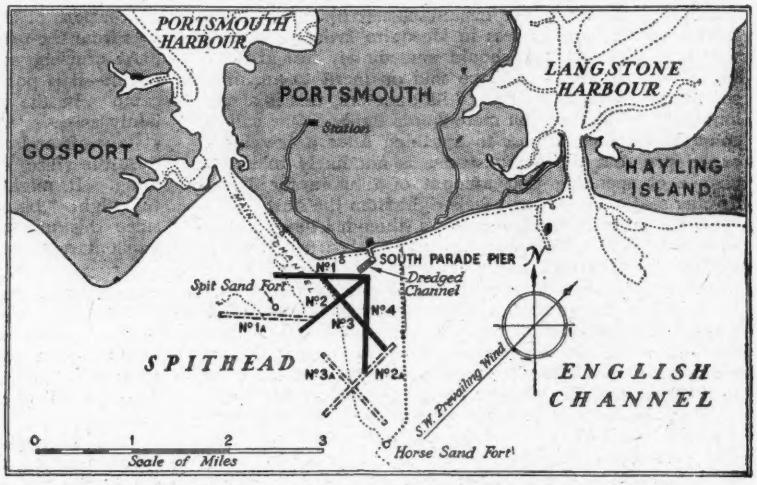
Proposal for Flying Boat Interim Base

THE long outstanding problem of finding a suitable flying boat base for B.O.A.C. has now come into prominence again as a result of the decision to use Southampton Water as an interim base until some satisfactory permanent marine base can be developed.

Mr. Ivor Thomas admitted recently in the House of Commons that a permanent base could not be developed in less than two years, and that the cost of providing temporary docks and other accommodation at Southampton so that Berth 50 can be used by B.O.A.C. instead of Poole was £80,000. Further, there is bound to be many months' delay before such temporary accommodation can be completed.

Since these announcements were made, a new scheme for a temporary base, this time at Southsea, has been submitted to the Ministry of Civil Aviation by Portsmouth Corporation. The position now is, therefore, that rival schemes have been proposed for permanent bases for Southampton utilizing the Solent, and for Portsmouth utilizing Langstone Harbour, and also schemes for temporary interim bases for Southampton in Southampton Water, and for Portsmouth at a point off the South Parade Pier at Southsea.

The latter temporary scheme has been proposed by Wing Cdr. R. D. Coath, who is Manager of Portsmouth Airport, and it is primarily centred around the fact that the Royal Beach Hotel, which is opposite the South Parade Pier at Southsea, could be made available as a headquarters, thus avoiding the necessity for building terminal buildings. The Portsmouth Corporation, which has occupied the hotel until recently, is transferring its municipal offices to new premises. As a matter of interest it is claimed that the company which owns the hotel would be glad to lease it for the time being, owing to the difficulty of obtaining staff and equipment for private enterprises of this nature.



The proposed alighting area for the flying boats lies immediately off-shore from the hotel, and is between the defence barrage which runs out from the South Parade to the Horse Sand Fort on the eastward side, and Spithead on the west, as can be seen from the accompanying map.

Four different operating methods have been suggested for this site. The first is to position a flying-boat dock at the end of South Parade Pier; the second entails the building of a temporary jetty and attaching to it a flying-boat dock; the third utilises a "Lily" raft as a landing jetty; and the fourth necessitates anchoring a flying-boat dock some distance off-shore and shuttling passengers in launches between this dock and the pier.

Apart from the tremendous saving in expense, labour and material which could be effected by using an existing hotel as a headquarters and terminal building, other advantages the sponsors claim are that it would be possible to operate at this location on what would virtually be a 24-hour basis; that the proposed alighting area is comparatively free from shipping and partially sheltered by the barrage; that there is a fast electric train service between Portsmouth and London (1½ hours); and that the site is adjacent to the arterial road to London. The last two advantages would bring passengers nearer in both time and distance to the capital, a point which, as we have constantly emphasized, is of vital importance in international air travel. There is also Portsmouth Airport which is only a few minutes away by road, and which could be used to provide a base for feeder services to other parts of the country.

So far as the alighting area is concerned, a certain amount of dredging would be necessary, depending on which of the four operating methods was selected and also on whatever final requirements as to size of channel were laid down by B.O.A.C. There is the disadvantage of ocean swell to be considered, but the sponsors suggest that this might be tolerated as the scheme is only temporary and that further, in the event of conditions becoming too rough, aircraft could be diverted. Such diversions, however, would, we feel, create numerous difficulties.

INACTIVE ACTIVITY

WHEN he was asked in the House of Commons by Mr. Keenan recently whether negotiations for the disposal of Ronaldsway air station to the Isle of Man Government had been successful, Mr. Dugdale, the Parliamentary and Financial Secretary to the Admiralty, said that there had been negotiations, but for the present they were in abeyance. When asked by Mr. Oliver Stanley whether "abeyance" meant the same as "active consideration," Mr. Dugdale replied it did mean very much the same thing. This confirmation of the subtlety of official jargon will hardly be a surprise to those who have had to endure it for the last few war years.

FROZEN FEEDING

IT is perhaps well known that "frozen" cooked meals are being served on transport aircraft, but something which may not be quite so well known is that for the past four months British South American Airways has been serving its passengers on the Lancastrian service with "Frood," a form of frozen food which has been processed by Messrs. J. Lyons. The latter company has, for more than two years, been experimenting with frozen cooked food and, in co-operation with the General Electric Company, has designed a special oven for heating these frozen dishes in the galley of an aircraft. Every item of food is cooked, frozen, and heated separately, and thus passengers are able to select the dishes they want. This is one of the important differences between "Frood" and the American "pre-dished" frozen meals, for, in the case of the latter, the complete meal is served on one "divided" plate, and this has obvious limitations. Lyons have been setting themselves a high standard in the production of "Frood,"

for once frozen, it can be kept in store for twelve months or even longer without any signs of deterioration. Almost every kind of food can be submitted to this process, although there are, at present, difficulties in the case of such dishes as grills and roast meats, where, in the heating-up process, an undesirable second cooking stage is introduced. However, it is hoped that this problem will be overcome in due course.

As an example of the efficiency of service of this kind, the weight of the oven is only about 30 lb, and a completely sealed carton of twelve meals, including entrée, vegetables and dessert, weighs, on an average, some 16 lb and occupies a space of approximately .35 cubic ft. Another important feature is that every morsel of food which is inedible has been eliminated before the meals have been loaded into the aircraft.

TRANSATLANTIC DUTCHMAN

WHEN the first of the K.L.M. "Flying Dutchman" D.C.-4s to fly on the regular transatlantic schedule landed at Prestwick on May 21st on its westbound flight from Amsterdam to New York the passengers and crew were received by the Lord Provost of Glasgow, Mr. Hector McNeil, and by a distinguished party from Northern Ireland which included Sir Basil Brooke, M.P., the Prime Minister, Sir Rowland Nugent, Minister of Commerce, and Sir Crawford McCullagh, Lord Mayor of Belfast. On the Atlantic stage of its journey the aircraft carried 32 passengers, amongst them Mr. H. Veenedaal, the Technical Managing Director of K.L.M. The first scheduled eastbound flight arrived at Prestwick on May 23rd, with 43 passengers.

LONDON'S AIRPORTS

FROM to-morrow, the transatlantic flights of Pan American World Airways and American Overseas Airways will terminate at the London Airport, instead of Hurn. As announced in *Flight* last week, the two companies have planned their services to arrive simultaneously to-morrow at about 1 p.m. in order to inaugurate this change of terminal point. In addition to the daily services of Panair and A.O.A., the Panair do Brazil weekly service to Rio will also use the London Airport in future. As can be seen from the photograph below, the American passenger accommodation will be distinctly austere for the time being!

A similar change of terminal has also been made by B.O.A.C., whose Lancastrian service to Sydney is now operating from London Airport instead of Hurn. In addition, the B.O.A.C. services to and from the Middle East and Accra, West Africa, are now operating from Northolt instead of Hurn.

Croydon Airport featured in question time in the House of Commons on May 22nd, when the Under-Secretary of State for Air declared that it was already under civil control, and that the only reason for delaying the move of the Transport Command squadron, which is still stationed there, was the inability of operators to take over the civil air services to the Continent which the squadron is running.

The Under-Secretary also stated that Northolt was already a civil airfield. If that is the official Air Ministry point of view, it seems a pity that, as in the case of Croydon, the R.A.F. continues to use exclusively almost all the best accommodation at the airfield.

"Flight" photograph.

TRANSATLANTIC TERMINAL: In New York, for a little over £100, a transatlantic air passage can be booked on an American airliner to London Airport, and when one arrives, one will be received—in a tent. Here are some of the tents being erected last week because no other form of accommodation can be made available in time for the first aircraft which arrive to-morrow.

TRAFFIC TERMINAL DEADLOCK

THE problem of finding a passenger terminal in London remains unsolved. When Lord Winster replied in the House of Lords on May 23rd to Viscount Swinton's question about the use of Earls Court, he not only scotched any idea of using the exhibition building as an air traffic terminal but he also gave no indication that any suitable alternative had either been considered or was available. In fact, with a neat bit of buck-passing, the Minister who, let it be remembered, is to have the absolute powers of a dictator under the new Civil Aviation Bill, said that the provision of a central depot in London for handling air traffic was a matter for the three Corporations, and not for the Government.

The fact that there are only very temporary passenger handling facilities at all London's airports makes the problem much more acute, for there is little doubt that if complementary passenger facilities of a less austere nature could be provided quickly in London, the bleak conditions prevailing at the airports would be, to a certain extent, offset. Obviously, the only way to provide suitable facilities quickly is to use an existing building, and a big one at that, even if only as a temporary measure until some properly planned and permanent air traffic centre for London can be built.

Although it is far from ideal, Earls Court exhibition building has obvious advantages, as Viscount Swinton pointed out, both from the point of view of size and of existing travelling facilities, but the building is scheduled to house the British Industries Fair in 1947.

Is there any other suitable building within the centre of London? We doubt it. Lord Winster himself said that Airways Terminal at Victoria can handle only 800 passengers a day, and then declared that we have to think in terms of 3,000 a day by *next year*. What then is the answer? Again, to quote the Minister, the Corporations are actively engaged in considering short-term plans for supplementing the inadequate accommodation. Is the Minister, however, prepared to give the Corporations all the necessary priorities of labour and material, or will lash-up facilities such as exist for passengers at all London's airports be perpetrated anew in London itself?

In the meantime, until a decision about an ultimate terminal-point in London is reached, the lack of adequate travelling facilities between the capital and London Airport proper must continue, for the one is inextricably bound up with the other.

So there the matter remains, unless a quick and adequate solution is found, or unless, as Viscount Swinton suggested, the Minister of Civil Aviation refuses to take the Earls Court decision "lying down, but will go back and fight for it." However, in view of the Minister's statement that the task is one for the Corporations, there seems to be no need for him to do this, for he has already provided a scape-goat against future breakdown—in fact, he has provided three of them.

AIRPORT APPOINTMENTS

THE appointment is announced by the Ministry of Civil Aviation of Mr. Roger C. Pugh as Airport Manager at the London Airport at Heathrow. Mr. Pugh, who is 44 years of age, was appointed as the first airport manager at Poole in March, 1944. In November of that year he took over the administration of Hurn from the R.A.F. and reorganized the airport on a civilian basis. His post at Hurn is being taken over by Group Capt. W. R. Cox who, before he left the R.A.F. at the beginning of this year, was for a long time the Staff Officer in charge of Administration to the Transport Command Group which operated the Mediterranean and Middle East sections of the U.K.-India trunk air route.

Simultaneously, B.O.A.C. have announced that their station manager at London Airport will be Mr. G. R. Hawtin. He has for some time been holding a similar position at Bournemouth, where he has been responsible for B.O.A.C.'s main land base at Hurn and for their marine terminal at Poole. Mr. Hawtin is 39 years old and has been with Imperial Airways and B.O.A.C. for 18 years. He is one of the only two senior Station Managers in the Corporation and, in this capacity, he holds a rank "one ring greater" than that held normally by a B.O.A.C. station manager.

Airworthiness Requirements

IN view of the fact that the system of granting Certificates of Airworthiness is at the moment in a state of flux, the following explanation by the Air Registration Board should help to clarify the position. It was in 1937 that the Secretary of State for Air delegated to the A.R.B. the responsibility for issuing requirements for civil aircraft up to 10,000 lb weight. In 1940 this was extended to include all aircraft, but during the war the work was suspended. The position is that the Board tenders its advice and recommendations, but has no legal authority to enforce them.

The present position is conditioned by two developments of the reasonably near future. The Air Navigation (Consolidation) Order and the Air Navigation Directions are under revision, and when the revised editions are published under the title of the Air Navigation (General) Regulations, they will indicate that the Minister will only grant a Certificate of Airworthiness to an aircraft which has been designed and constructed in accordance with the published requirements of the Board. This will obviously alter the position and will mean that the Board's requirements will have a different legal standing and *must* be met by the aircraft designer, or, alternatively, the designer must persuade the Board that he has provided an equivalent standard.

The second consideration is that the British Government will undoubtedly adopt the findings of the Provisional International Civil Aviation Organization (P.I.C.A.O.) in place of I.C.A.N. Whereas I.C.A.N. never published detailed requirements, P.I.C.A.O. has already agreed a fairly detailed code. The Board has been concerned with this from the beginning and has made certain recommendations which it put forward recently at the meetings of the Airworthiness Division of P.I.C.A.O. at Montreal.

At these meetings the United Kingdom delegation consisted of the Chairman of the Board and members of its staff. The basis of their discussions was the recommendations that the Board had made to the Minister and which were circulated before the meetings.

The requirements agreed at the meetings in Montreal will also be circulated and will eventually be included in the British Civil Airworthiness Requirements because, when the regulations made by P.I.C.A.O. are adopted as the British Regulations, the airworthiness requirements will be put into force in this country as a Government responsibility.

The Board's responsibility at the moment, therefore, is to give the Minister such advice as it knows is generally in accordance with the principles adopted by P.I.C.A.O.

In the meantime the constructor's position is that if he builds an aircraft to a standard lower than that recommended by the Board, he will find that a Certificate of Airworthiness will not be issued to any prototype or series aircraft which does not comply with international standards after January 1st, 1951, and that in any case such aircraft will not be permitted to operate internationally after January 1st, 1954.

THE D.H. CHIPMUNK

DE HAVILLAND AIRCRAFT OF CANADA have built and flown their first aircraft of entirely domestic design—the D.H.C.1, or Chipmunk. It was flown by Mr. Pat Fillingham, chief production test pilot at Hatfield, who is now on a visit to Canada.

The Chipmunk is an all-metal low-wing cabin monoplane with two seats in tandem, while the D.H.C.2, a side-by-side version, is now under development. The all-up weight is about 1,780 lb. A D.H. Gipsy Major Ic gives it a top speed of 152 m.p.h. and a cruising speed of 133 m.p.h. Later Chipmunks will have Gipsy Major 30s, which will raise the speeds, and the fitting of the D.H. manually variable pitch airscrew will further improve performance.

C.U.A.S. 21st BIRTHDAY

THE Cambridge University Air Squadron celebrated its twenty-first anniversary on Friday, May 24th, with a dinner held at the University Arms Hotel, and it was good to see so many old friends renewing acquaintance.

Marshal of the Royal Air Force Lord Tedder was prevented from attending owing to the arrival of a son and heir (congratulations!), but Air Chief Marshal Sir John Slessor made a noble deputy. He commented that this year, 1946, was, perhaps, the most difficult the R.A.F. had ever experienced, for the present is a very sticky transitional period from war to peacetime establishment. The great trouble of the moment is lack of policy, for it is too early as yet to form rigid ideas of peacetime strength. It is not yet known, for example, whether or not the National Service Act will come into being—if it does, it will be important to university men in stipulating as to whether they are required to do their national service before or after their university training. Sir John further went on to say that the newly formed Technical Branch of the R.A.F. is expected to recruit its officers almost wholly from the universities.

Mr. H. Thirkill, the Vice-Chancellor, propounded the view that the aeronautical engineer is better off for having some flying experience, and, too, the pilot is better off for having some knowledge of science. In such case, the C.U.A.S. was happily placed in its close association with the science side of the University. It has been strongly requested that the scientific establishment of the University be increased, but that is impossible until the building labour position allows greater laboratory accommodation to be made available. Cambridge could look back on its war record with a good deal of pride; over 100 decorations had been earned by C.U.A.S. men, but many old members of the Squadron were gone for ever.

Of the Squadron itself, the commanding officer, Wing Cmdr. Nigel Bicknell, reported that the present strength comprised three Tiger Moths, one Hillman Minx with a broken differential, and three bicycles, but it was hoped that, as time went on, this position would be materially altered. Undergraduates are allowed five hours' flying per term, and are not permitted to fly solo under twelve months' dual. One undergrad has bought an Auster and is flying to Ceylon during the long vac, but until his dual period is completed he will not be allowed to fly Squadron aircraft solo. There was some laughter at this, and also at the quiet comment that the president of the Oxford U.A.S. had learned his flying as a member of the Cambridge Squadron.

COBHAM ACTIVITIES

THE first of the Skyways, Ltd., charter flights which, as we mentioned in last week's issue, was to Basra and back, was successfully completed to schedule. The York flew via Castel Benito to Cairo where it made a night stop. The second day it went on to Basra via Lydda, was turned round, and flew back to Cairo by the same evening, making its second night stop there, and finally returned from Cairo on the third day of the trip, arriving back at Manston on schedule at 6.30 p.m. Throughout the journey the passengers were fed on board the aircraft which carried supplies of frozen food.

The master of the aircraft on this occasion was Capt. Ashley, who is managing director of the company and to whom much credit is due for dealing with the mass of detail organization which was necessary before Skyways, Ltd., came into being. Sir Alan Cobham is deputy chairman of the company, of which Brig. Gen. A. C. Critchley is chairman. Apart from the charter contract with the Anglo-Iranian Oil Company, Skyways' Yorks are also carrying out the Swiss luxury cruises for Sir Henry Lunn, Ltd., the travel agents.

Sir Alan Cobham's other interest is, of course, flight refuelling, and the latest development in this sphere was the beginning last week of the Ministry of Civil Aviation's trials at Ford airfield in conjunction with Flight Refuelling, Ltd., and British South American Airways. Capt. Prowse has joined the staff of Flight Refuelling, Ltd., and it is interesting that once the system had been explained to him on a ground trainer, he was able to undertake refuelling in the air successfully at the first attempt. The trials, which are being operated by a panel composed of representatives from all the appropriate Ministries, may continue for several months.

NEWS FROM THE CLUBS

Following the appearance of "ground facilities" on May 19th, the Herts and Essex Aero Club has now started flying with an Auster V. One Tiger Moth has been allocated in the usual way and should now be available, while a Hornet Moth is also expected.

* * *

The Royal Artillery Aero Club hopes to start flying at High Post on June 10th, and will hold an initial gliding meeting on July 6th and 7th. Members who wish to fly at H.P. should make direct arrangements with the Wiltshire School of Flying (Middle Woodford 57). The gliding meeting will be held at Knighton Down, Larkhill.

FLIGHT
May 3
1945

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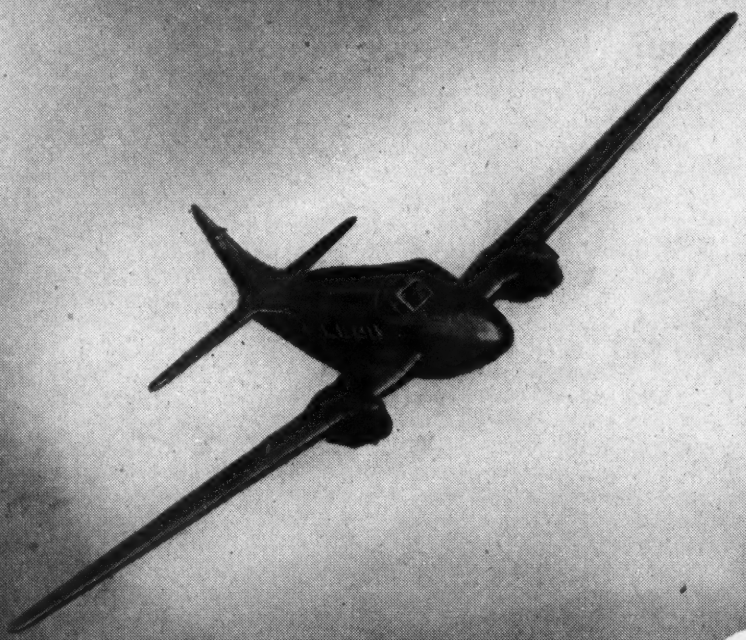

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Air Conditioning Large Civil Aircraft

LECTURE BY D. R. POBJOY, B.Sc., F.R.Ae.S.

Considerations of Refrigeration and Humidifying Equipment

IN a lecture entitled "Pressurizing and Air Conditioning of Large Civil Airoraft," which he was invited to give before L'Association Française des Ingénieurs et Techniciens de l'Aéronautique in Paris on May 28th, Mr. D. R. Pobjoy, whose name will be familiar to readers in connection with various Rotol equipment and the Pobjoy Niagara radial engine, had some quite interesting things to say on the subject of refrigeration and humidification. The main body of the lecture was devoted to general considerations of the overall pressurizing problem, but as these have previously been quite exhaustively dealt with by this journal we are confining ourselves to that part of the lecture which is likely to be of newest interest.

The lecturer stated that temperature and humidity are, for comfort, linked together, the ideal average condition being 68 deg. F with a relative humidity of 50 per cent. The control of humidity has scarcely been attempted in aircraft; it is, however, necessary for comfort. A practical solution of the problem, which involves the use of a refrigerator and a reheater, is to produce fully-saturated air at 50 deg. F. The moisture content of saturated air at this temperature is such that when heated to 68 deg. F the relative humidity is 50 per cent. To balance the transfer of heat through the aircraft walls and from the occupants' bodies, the saturated air should be brought in the reheater

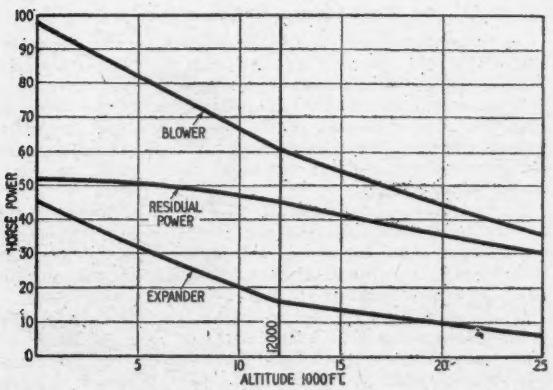


Fig. 1. Curves of refrigeration circuit powers with cold-air blower on minimum output.

to a temperature higher than that of the cabins when the outside conditions are cold, and to a lower temperature in hot weather.

One form of humidifier consists of a series of fine jets directing water spray against the airflow. Excess water falls to the bottom of the apparatus and is returned to the tank by a small pump. The maximum demand for water will naturally arise at high altitudes, and for an aircraft carrying 100 occupants the water consumption may amount to 40 lb/hr. It must be understood that when the ingoing air is already humid, less water can be absorbed, and although the sprays continue to function, the water falls to the bottom and is recirculated.

Unless the air is already fully saturated, the addition of water by spray will lower its temperature; on admission to the humidifier its temperature must, therefore, be between 50 deg. F for already saturated air to 79 deg. F for dry air. The air, having been fully saturated to 50 deg. F,

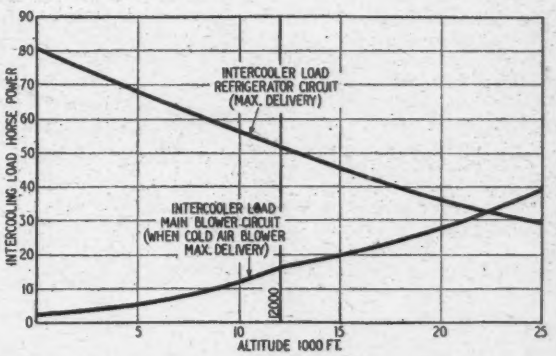

INTERCOOLING LOAD HORSE POWER
INTERCOOLER LOAD REFRIGERATOR CIRCUIT (MAX. DELIVERY)
INTERCOOLER LOAD MAIN BLOWER CIRCUIT (WHEN COLD AIR BLOWER MAX. DELIVERY)
12000
ALTITUDE 1000 FT.

Fig. 2. Curves of intercooler loads in main and refrigerating circuits, with maximum cold-air blower delivery.

must now be reheated. For a typical aircraft it appears that in severe conditions such as sub-Arctic winter at 25,000ft, the temperature of the air leaving the reheater will need to be 150 deg. F. By the time this hot air has circulated through the aircraft its temperature will have steadied at the optimum figure of 68 deg. F which, for 120 lb of air/min., represents a heat addition of 45,500 calories/min. It would not do to discharge such hot air directly into the cabin. Instead, the cabin air should be recirculated once or twice by means of a fan and join the hot air just downstream of the reheater. In hot weather the reverse holds good, and the air must be reheated to a temperature less than that of the outside air to compensate for the heat absorbed by the aircraft structure either from the air or from solar radiation, and that given off by the passengers themselves.

Refrigeration

On the subject of refrigeration, the lecturer commented that it is a necessity in hot weather, especially during the first 10,000ft; moreover, it is an essential part of the humidity control. The principle has now been generally adopted of using the ventilation air itself as a medium, the equipment comprising a compressor, intercooler and expander.

The efficiencies of the compressor and expander are of great importance. If the former is too low, the intercooler

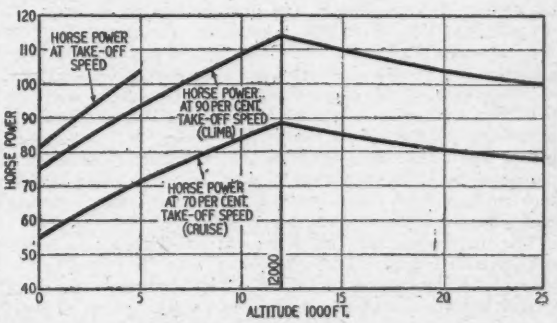

HORSE POWER
HORSE POWER AT TAKE-OFF SPEED
HORSE POWER AT 90 PER CENT. TAKE-OFF SPEED (CLIMB)
HORSE POWER AT 70 PER CENT. TAKE-OFF SPEED (CRUISE)
12000
ALTITUDE 1000 FT.

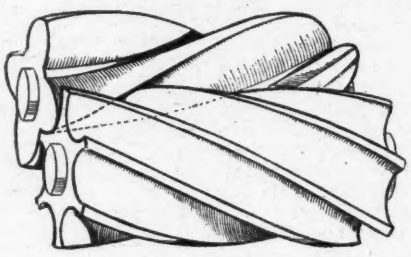
Fig. 3. Curves of power absorption for main and refrigerating blowers under tropical summer conditions.

AIR CONDITIONING LARGE CIVIL AIRCRAFT

must be large and its cooling drag therefore excessive. If the efficiency of the expander is too low, the air may come out hotter than it went in.

One scheme now under development follows the trend of modern power plants. A centrifugal blower compresses the air to a ratio of about 3 : 1, the heated air then passing through an air-cooled intercooler, finally expanding through a single-stage turbine. The mechanism thus resembles the gas turbine except that heat is extracted at constant pressure instead of being added. The compression ratio being proportional to the square of the speed, difficulty might be experienced when driving from a main piston engine unless a constant-speed drive were employed. With turbine main engines the difference between take-off and cruising r.p.m. is so small that fixed drive could be used.

At first sight this installation could be combined with the main compressor if the latter were of centrifugal type; however, in this case it would not be possible to slow down the main blower to ½ speed at ground level, because there would then be no compression for the refrigerating system. It would be necessary to run at full speed, which would result in compressing and refrigerating three or four times as much air as necessary. This would demand a huge intercooler (already quite large enough from the drag point of view) and a serious consumption of power, needing a substantial driving gear.



Detail sketch of Lysholm-type blower rotors showing complementary profiles of lobes for progressive compression.

One solution of this difficulty is to have a separate refrigerating machine running at constant speed and just large enough to supply all the air required at ground level. In addition, a main centrifugal blower with a three-or-four-to-one variable speed gear would gradually take up the supply as the altitude increased. Fig. 1 shows the power required to operate the refrigerator (100-passenger aircraft) if designed, as mentioned in the previous paragraph, to be just large enough for ground-level requirements. The upper curve shows the power absorbed by the compressor; the lower curve the power regained in the turbine; and the middle curve gives the net power required to drive the installation. A refrigerator is seldom necessary at high altitude, and the power shown can be saved by de-clutching the drive.

Temperature Sequence

Temperature drop through the refrigerating system depends upon the humidity, being greatest with dry air. The intercooler is supplied with atmospheric air through a suitable duct. Under dry tropical conditions the air may enter the machine at 104 deg. F, rise to 284 deg. F, drop to 140 deg. F in the intercooler, and finally fall in the expander to 32 deg. F. This is, of course, too low, and the intercooler shutters would be partially closed by a thermostat at the humidifier exit. However, with 50 per cent atmospheric humidity, the final temperature at admission to the cabin would be 68 deg. F. At higher initial humidities and temperatures the initial cabin temperatures will be somewhat higher than the ideal figure, but probably acceptable, especially soon after entering and before leaving the aircraft.

The intercooler load for a typical 100-passenger aircraft is shown in Fig. 2. The intercooler may be 12in × 33in × 18in and weigh about 62 lb. With its shutters wide open it will require about 180 lb/min of cooling air at a pressure of 12in of water. The same duct will do for the intercooler and for the main compressor cooler, as they are not normally in action together.

In very cold weather, near the ground, the same condition of dryness may obtain as at altitude. The air must, therefore, be heated before it reaches the humidifier, and near the ground the refrigerator will do this automatically. The humidifier thermostat would close the intercooler shutters and the mass-flow valve would by-pass the main compressor, thus the entering air would be compressed and re-expanded in the refrigerator without intercooling. Despite the high efficiencies of the installation, there would be enough residual work done to supply the heat required.

For all except the largest aircraft, and particularly for those having main compressors of the Roots type operating at 25,000ft or less, an alternative to the high-speed turbine refrigerator is to use two displacement compressors (mounted on the same gear box as the blower) with the usual intercooler between them. At the necessary pressure ratio of about 3.5 : 1 a Roots type blower has too low an adiabatic efficiency. Instead a compressor and expander of the Lysholm type might be used. While superficially resembling the Roots type, Lysholm blowers have rotors of peculiar form which draw in air at one end, progressively compress it within the rotors and deliver it continuously at the other end. The adiabatic efficiency is very high and, in the smaller sizes, is superior to that of centrifugal types.

Combining Efficiencies

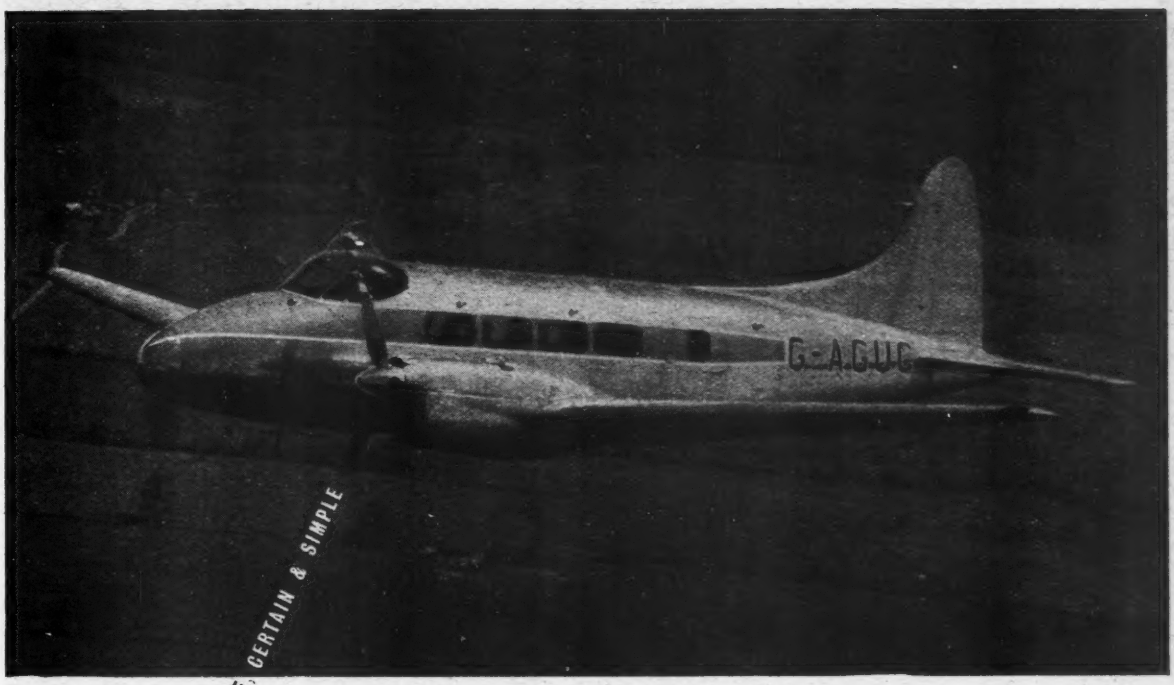
As the compression ratio is determined by the geometry and not by the speed of rotation, this type is particularly suitable for use with piston engines, and a fixed drive may be used with some simple clutch to disengage the drive as required. The main blower, if of the Roots type, requires a fixed drive, and the three units (main blower, Lysholm compressor and Lysholm expander) could all be mounted on the same gearbox.

For a 100-passenger aircraft the total power required for driving each (duplicated) set of main and refrigerating compressors is shown in Fig. 3 from which it will be seen that 80 h.p. is required at take-off, rising steadily during climb to a maximum of 110 h.p. at 12,000ft.

If the simplicity of operation at low altitude of the Roots blower could be combined with the efficiency at high compression ratios of the Lysholm blower, the main compressor could be of this type up to 40,000ft, and a variable-speed drive would be unnecessary. This may be done by providing a Lysholm blower with a valve on its delivery side which, when open, virtually transforms the unit into a Roots blower with no internal compression ratio. Up to about 20,000ft the valve would be open; above this height the valve would be closed to obtain efficient compression at high altitudes.

FORTHCOMING EVENTS

May 30th.—R.Ae.S. The 34th Wilbur Wright Lecture by Mr. E. L. Relf (I.C.E., Gt. George St.).
June 1st.—R.Ae.S. Reading and Dist. Branch; Aeronautical Garden Party, Woodley.
June 15th.—Old Cranwellian Assoc. reunion, R.A.F. College.
June 15th.—No. 150 Sqn. R.A.F. reunion dinner, Dorchester Hotel, 6.30 p.m.
June 19th.—Sir Frederick Handley Page at Gauge and Tool Makers' Assoc. luncheon, Savoy, 12.30 p.m.
June 22nd.—Air Pageant, Southampton Airport.
June 30th.—Northern Heights M.F.C. Gala day, Langley Airfield Nr. Slough.



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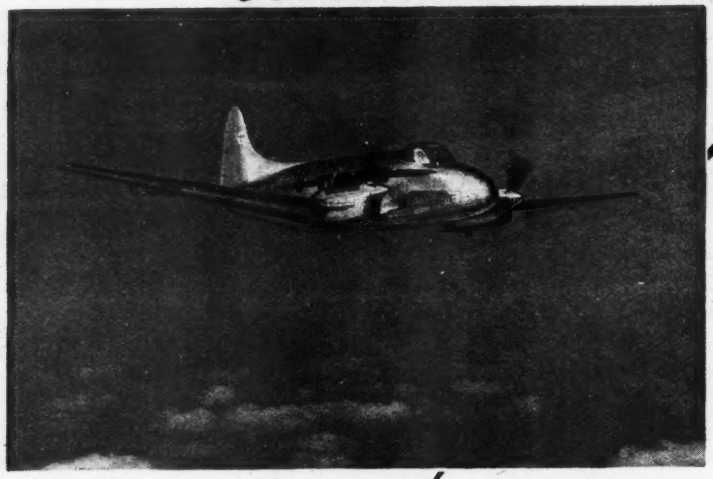

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CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

LONDON AIRPORT

Site for Proposed World Fair

WE note with envy that New York has a fine, if not the finest airport in the world at Idlewild. However, if England had her World Fair on London's Airport, as America did on Idlewild, could we not improve the whole outlay?

With a tangent plan runway, such as the one suggested in *Flight*, May 16th, the bare necessities of an airport are at least a good control tower and an Underground to London. With that paid for by the Fair proceeds and also the extra buildings, hotels, restaurants, etc., all left up for the use of the airport, not only would it improve London Airport, but it would give easy access for aircraft from home and abroad flying in for a day to the Fair.

P. A. C.

Modern Terminal Essentials

WITH reference to the above, I still maintain that my scale drawing published in your Correspondence column some time ago takes care of the following essential features desirable in a modern metropolitan air terminal, viz.:—

1. Elimination of underground thoroughfares and underground car parks.
2. Centralization of control tower, passenger and goods stations.
3. Last but not least, the placing of the control room and its relationship to the rising, midday and setting sun. Incidentally this is a factor directly responsible for accidents due to errors in air traffic control.

I would remind the responsible authorities that the victimization of pro-American officers in the Air Services is not the open road to efficiency, and may cause millions of pounds Sterling to be spent on elaborate airports which, by the time they are completed, will be obsolete from an international point of view and the cause of many headaches for future air traffic superintendents. It is easy to understand the keen rivalry between the "air powers" and the Federal Bureau of Aeronautics, which is not only legitimate, but the source of financial gain, together with commercial and military ascendancy in future years.

W. REGINALD DAINTY, Hon. Capt. R.A.F. (R.N., R.F.C.).

KEEPING THEM RUNNING

The General Novelty of the Gas Turbine

IN reply to the letter from Sqn. Ldr. Cracknell (*Flight*, May 9th), I must say that I still cannot agree that he was justified in stating that in the event of erratic operation "it is customary to change the throttle valve or a.c.u." There is a type of mind, common in the Services, which tends to lay the blame on a particular component if anything goes wrong, and which will do so for no apparent reason. It is usually a case of a little learning being a dangerous thing, probably due to the general novelty of gas turbines. Such a statement as that referred to above is likely to be fastened upon and the most literal construction placed upon it.

That even E.O.s are not exempt from the attitude is shown by the authenticated instance of an E.O. who, on hearing unusual and expensive noises coming from a Meteor nacelle, had the engine changed, in the belief that the wheelcase was faulty. When the replacement unit was started up, the same noises were heard. Subsequent investigation showed that the auxiliary gearbox was at fault.

Further to Sqn. Ldr. Cracknell's letter, I wonder if he has ever come across a case of nozzle guide vane aerodynamic breakdown without any attendant mechanical distortion?

While appreciating that the article in question was written for no specific design, I must confess that when writing my first letter I was thinking in terms of the more successful types at present in production, or in the advanced stages of development, in this country. The recipients of his lecture are not very likely to deal with the German engines referred to.

By virtue of his position, Sqn. Ldr. Cracknell has probably had a greater experience of ex-enemy types of gas turbines than any other E.O. in this country. I suspect that it is from this experience that the Squadron Leader gains his knowledge of the a.s.g. and of air-cooled turbine blade systems, but the fact remains that few British engines use them at the moment.

R. E. T. HACK.

FLIGHT OF BIRDS

Wild Geese as an Example

ON page 477 of *Flight*, May 9th, appears a letter from Mr. Stanley Bradshaw on the flight of birds. I quite agree with his theory, and not with that of Dr. Julian Huxley.

When I was at Rochester I observed flights of wild geese in V-formation. The leader kept his position. I saw the two birds immediately following leave the formation at the same moment and with a beautiful gliding curve join up again at the end of the formation.

The V-shape formation was not for a moment distorted by their action. I am of the opinion that birds, like aircraft pilots, avoid the "down draught" of wings ahead of them because it leads to instability.

H. O. SHORT, F.R.Ae.S.

[Our correspondent's last sentence supports Dr. Huxley's contention that the explanation is one of aerodynamics.—ED.]

FOOL-PROOF FLYING

Aircraft Becoming Too Complicated

THE American Newsletter in *Flight*, May 16th, and your comments on it, bring up some vital aspects of flying which are a great worry to many enthusiasts. I, for one, would welcome more discussion on the subject. For commercial aviation with large-scale organization, there are great possibilities, as there were in the early days of railways and steamships. The same may also apply to the "fly-yourself" hire arrangements. For the private enthusiast of moderate means, however, owning his aircraft and requiring cheap but fool-proof flying, present-day aircraft development appears to hold out little hope.

One feels that aircraft, like many modern developments, are becoming increasingly complicated, instead of the greater knowledge available making for simplification as it should ideally. There may be apparent simplifications due to "one knob" types of control, but the "workings" have often then become too complicated for one to do anything about them if things go wrong. It is thought that the only hope for private flying is in developments aimed at real simplicity and cheapness, and which may be in directions other than the more general aircraft trends that will be based on military or commercial performance. Again, such flying must not be dependent on airport organization, however excellent. In conclusion may one hope that somebody will think of something different from the conventional stationary-wing aircraft, or helicopter, as calculations made on their possibilities tend to leave one very pessimistic.

R. H.

THE PRICE OF COMFORT

Airliner Luxury Costs Too Much

WITH all the interest now centred on comfort in the new civil aircraft and their operation, I should like to make two observations bearing directly on passenger appeal.

Your journal is always very critical of passenger cabin layouts and their æsthetic and practical appeal, and this is a very proper attitude. But there is another side to it. The war has done much to make a very large section of the public air-minded—the up and coming public, too: the ex-Service members. Many of them have got used to air travel and take it for granted; they learnt of its advantages in Liberator bomb bays, or with the mail and the rations in a "Dak." They know aircraft are safe and reliable, and they won't worry overmuch now if the fuselage is "tunnel-like" or "the seat backs rather high" if the aircraft gets them there cheaply and quickly.

I think comfort is costing too much money. The majority of us can't afford present, or past, airline prices, and would possibly welcome less comfort at less cost. To illustrate my point—if there were two services to America, one in a Tudor I and another in a Tudor II with passengers installed in tiers in string hammocks at a quarter of the cost, I'm sure there would be a public for the cheaper service and that it would be the more profitable. It would make more people air-minded.

My other is an operating point. As a paratroop I did much flying, but could never get used to the bumps on the landing circuit. If this was kept up for long it was too bad. If great trouble is taken to make the rest of the trip comfortable, then this period at low altitude deserves special attention to keep it short. Moreover, since it is the last part of the trip, it may mar the passengers' memories of the rest.

"FUSILIER."

DRESS REHEARSAL: Meteor IIIs of No. 56 Squadron practise formation flying in preparation for the mass flight in the Victory celebrations on June 8th.

SERVICE AVIATION

Royal Air Force and Naval Air Arm News and Announcements

Appointments

Air Vice-Marshal R. M. Foster, C.B., C.B.E., D.F.C., to be A.O.C. at Air H.Q., Italy.

Air Vice-Marshal E. J. Kingston-Mcloughry, C.B.E., D.S.O., D.F.C., to be S.A.S.O. at Air H.Q., India.

Air Vice-Marshal R. L. Ragg, C.B.E., A.F.C., to be A.O.C. Administration at Air H.Q., India.

Air Vice-Marshal E. J. Cuckney, C.B., C.B.E., D.S.C., to be Deputy-Controller of Research and Development, Ministry of Supply.

Air Vice-Marshal R. O. Jones, C.B., A.F.C., to be Head of a Planning Staff formed to consider the future control and direction of technical services in the R.A.F.

Air Vice-Marshal T. Cathcart Traill, O.B.E., D.F.C., to be A.O.C. No. 12 Group (Fighter Command).

A.O.C., Reserve Command

AIR VICE-MARSHAL SIR ALAN LEES, K.B.E., C.B.E., D.S.O., A.F.C., has been appointed Air Officer Commanding-in-Chief, Reserve Command.

Sir Alan has been directing the arrangements for the re-establishment of auxiliary and reserve forces since August, 1945. Last February he became Chief Commandant and Director-General of the A.T.C., an appointment which implemented the announced policy of integrating the A.T.C. with the Air Force Reserves, and which he will retain.

Retirement

AIR VICE-MARSHAL SIR LEONARD ISITT has relinquished his appointment as Chief of the New Zealand Air Staff.

The New Zealand Government has appointed him chairman of the N.Z. National Airways Corporation.

Air Comdre. A. Nevill has been appointed the new Chief of Air Staff, with the rank of Air Vice-Marshal.

A.T.C. Guard of Honour

FIFTY A.T.C. cadets from four London squadrons, and the central A.T.C. band of London Command, will form a guard of honour for Marshal of the Royal Air Force Lord Tedder when he receives the Freedom of the City of London on May 28th.

The privilege of mounting a guard of honour in the City belongs by rights to the Honourable Artillery Company, but since the honour is being bestowed on the Chief of Air Staff, the Army has invited the A.T.C. to do so.

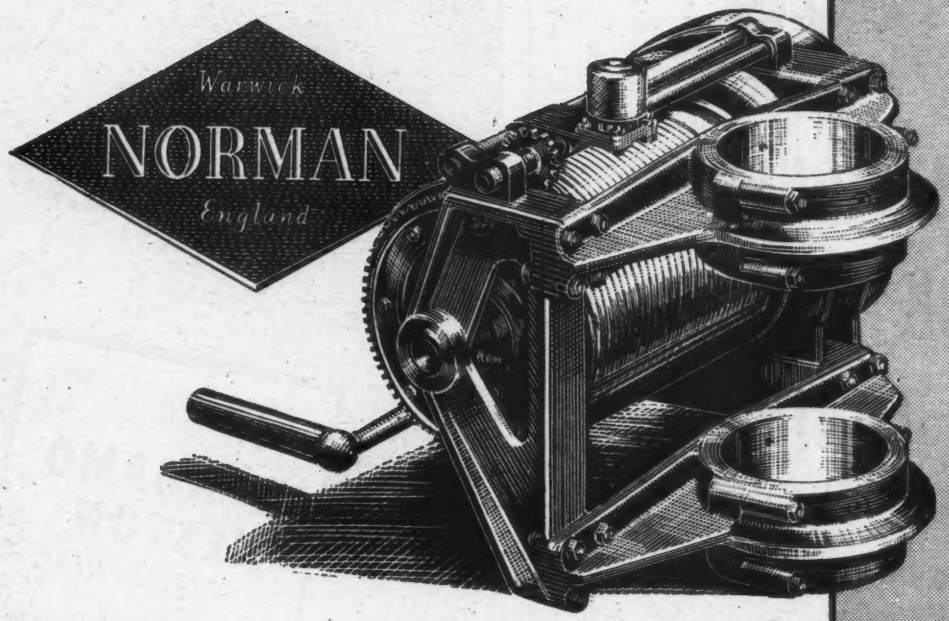
At the Guildhall, where Lord Tedder receives the Freedom, the guard of honour will consist of two officers and fifty men of Technical Training Command from R.A.F. Halton.

A.A. Command

MAJOR-GENERAL O. M. LUND has been appointed G.O.C.-in-C. of Anti-Aircraft Command in succession to Lt. General Sir W. Wyndham Green, who has retired.

Aircraft and the Atom Test

PILOTLESS aircraft will be used extensively in "Operation Crossroads," code name for the Bikini atom-bomb test. A whole squadron of "ghost" Hellcats operating from the U.S. Navy Carrier *Shangri-La* (27,000 tons), together with four Fortresses, will be flown through the huge pillar of smoke on their automatic pilots and picked up by radio control on emerging. Bags in the bomb bays of the Fortresses will collect samples of contaminated air. Superfortresses will be used to study effects of radioactivity on all types of film.



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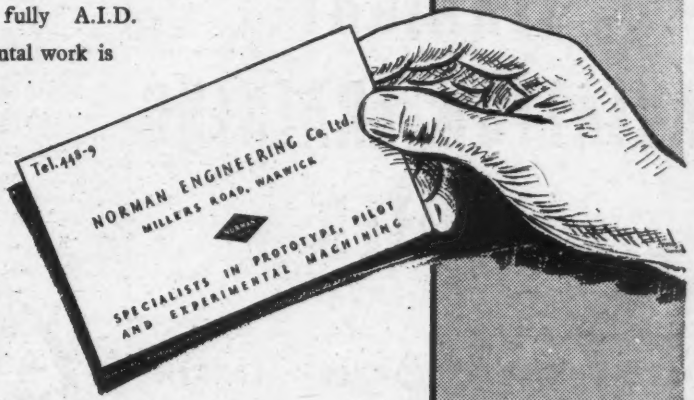

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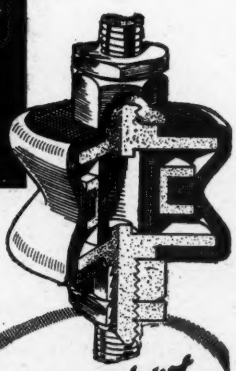

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SERVICE AVIATION

Naval Share

FOUR squadrons of the Naval Air Arm will be among the 300 aircraft to fly over on V-day. Although they will be flying the latest types on June 8th, the squadrons concerned operated during the war with Swordfish, Fulmars and Barracudas.

No. 811 Squadron, now equipped with Sea Mosquitoes, flew Swordfish throughout the war and escorted more than 20 convoys. It will be led by its C.O., Lt. Cdr. S. M. P. Walsh, D.S.O., D.S.C. and Bar, whose wartime experience includes attacks on E-boats, and mine-laying. Seafire XVIIs will be flown by No. 807 Squadron, which operated in the Mediterranean in 1940, flying Fulmars; its C.O. is Lt. Cdr. S. J. Hall, D.S.C.

In 1939 No. 816 Squadron was operating in the Channel with Swordfish until 1944, when, after one convoy to Russia, it converted to Barracudas and later to Fireflies, which it will fly on V-day... The Swordfish of No. 813 Squadron operated over the East Indies, the Mediterranean and the Atlantic; Firebrands now form the Squadron's equipment.

Awards

THE King has been graciously pleased to approve the following awards:

Military Cross

Flt. Lt. J. M. WOOD, R.A.F.V.R., No. 106 Sqn.
Flt. Lt. W. F. ASH, R.C.A.F., No. 411 Sqn.
Flt. Lt. B. A. JAMES, R.A.F., No. 9 Sqn.
Flt. Lt. P. STEVENS, R.A.F.V.R., No. 144 Sqn.
Capt. J. J. ORD, S.A.A.F., attd. No. 2 P.R.U., R.A.F.
W/O. D. D. P. LEITCH, R.A.F.V.R., No. 408 Sqn.
W/O. (now P/O.) V. J. BASTABLE, R.C.A.F., No. 106 Sqn.
W/O. D. YOUNG, R.A.F.V.R., No. 49 Sqn.
FLT. LT. F. M. BALL, R.A.F.V.R., R.A.F. Airborne Control Unit.

Military Medal

Sgt. A. C. HAINES, R.A.F.V.R., No. 2962 Sqn., R.A.F. Regt.
Temp. Cpl. L. D. S. GROOME, R.A.F.V.R., No. 2810 Sqn., R.A.F. Regt.
Cpl. J. W. FRANKISH, R.A.F.V.R., R.A.F. Airborne Control Unit.

Roll of Honour

Casualty Communiqué, No. 583.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 252 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED IN ACTION.—Act. Flt. Lt. E. S. Allen; P/O. J. R. Byrne; Flt. Sgt. A. B. Dennison; Flt. Sgt. G. A. Maginley; Sgt. E. T. Smith.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. W. Andrews; Sgt. S. W. Argent; Sgt. D. R. Lewis; Flt. Sgt. R. A. Pratt; Flt. Sgt. W. R. Riddle; Sgt. J. A. Robinson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. F. Ashworth; Sgt J. Astley; Sgt. S. Athorn; Sgt. C. E. Atter; Sgt. H. J. Bailey; Flt. Sgt. G. Bainbridge; Sgt. H. J. Bate; Sgt. E. Battye; Flt. Sgt. G. W. Bebbington; Flt. Sgt A. H. Bedggood; Sgt. R. H. Berret; Sgt. H. J. Black; F/O. H. Black; Flt. Lt. W. A. S. Blackden; Flt. Sgt. D. J. Blencowe; Sgt. W. G. Bogie; Flt. Sgt. A. S. Booth; Flt. Sgt. E. A. Borley; Sgt. G. H. J. Briggs; P/O. A. R. Brown; Flt. Sgt. E. L. Brown; Sgt. D. G. A. Bryer; Flt. Sgt. G. J. Burns; Sgt. A. C. Butler; Sgt. K. Callaby; F/O. A. W. Campbell; Flt. Lt. L. E. Carter; Sgt. S. W. Chalcraft; P/O. G. G. Clark; Sgt. H. Clayton; Sgt. L. P. Coles; Sgt. W. G. Colgrave; Flt. Sgt. B. Collinson; Sgt. A. Coote; P/O. L. Courtney; F/O. R. C. A. Cowles, D.F.C.; Flt. Sgt. J. C. Crabtree; Sgt. R. Craig; Sgt. J Dalby; Sgt. J. Dalley; Flt. Sgt. N. Daniels; Sgt. S. R. Davie; Flt. Sgt. J. E. Davies; Sgt. H. H. Day; Sgt. G. C. Dennis; Flt. Sgt. A. Diack; Flt. Lt. J. D. Dickson, D.F.M.; Flt. Sgt. A. Donnelly; Sgt. D. A. Dorey; Sgt. R. J. Dunster; W/O. F. Edgar; Flt. Sgt. J. E. Elley; F/O. F. R. Elson; F/O. D. W. Eves; F/O. J. Eyre; Sgt. F. A. W. Filer; Sgt. F. Forster; Flt. Sgt. D. C. Foster; Sgt. J. J Franklin; Flt. Sgt. T. R. Frayne; Flt. Sgt. W. L. Frost; Sgt. A. G. Furber; Flt. Sgt. J. A. Golding; Sgt. P. A. Gosnold; Sgt. M. A. Goult; F/O. A. L. Greenwood; Sgt. W. W. Hammond; Sgt. R. W. Harding; Flt. Sgt. J. G. Harris; Sgt. W. F. Hart; Sgt. W. Harvey; Sgt. J. R. Hassan; F/O. H. W. Hayward; Flt. Sgt. D. C. N. Hearn; Flt. Lt. P. Hetherwick; Flt. Lt. P. M. Hill; P/O. J. Holton; Act. F/O. T. D. Hooper; Sgt. T. J. Hooper; Act. F/O. J. H. Horspool; F/O. P. G. Hughesdon; Sgt. R. Hunter; Sgt. W. Irvine; Sgt. R. Jackson; F/O. H. F. Jones; F/O. J. D. Jones; Sgt. R. W. Jones; Flt. Sgt. J. F. Jordan; P/O. J. W. Jordan; Flt. Lt. J. L. Joynson; Act. Sqn. Ldr. P. Kelly, D.F.C.; F/O. A. E. Kitchen, D.F.C.; Sgt. R. C. Knee; Flt. Sgt. J. W. Knight; Sgt. A. Lackey; Sgt. J. Lambert; Flt. Lt. F. T. L'Amie; P/O. A. Leach; F/O. W. T. E. Legg; F/O. A. Leonard; W/O. T. A. Leyden; Sgt. K. J. Liggins; Sgt. J. E. Look; Sgt. F. W. Louch; P/O. C. H. McConaghy; Sgt. C. Mabbs; F/O. L. A. Martin; Sgt. P. C. Martin; Sgt. M. Martines; Sgt. I. Matthews; Sgt. F. G. Maunder; F/O. J. Mayson; Sgt. H. E. Medlock; F/O. R. G. Metcalf; Sgt. H. S. Metcalfe; F/O. M. J. S. Mohr; Flt. Lt. J. P. Morris; Sgt. M. H. Moss; F/O. P. D. Mullett; Sgt. A. G. Murphy; Flt. Sgt. C. A. Myers; Flt. Sgt. K. Naylor; Sgt. P. Neale; P/O. F. P. Newcombe; F/O. G. F. Nichols; Flt. Sgt. N. W. Nightingale; Flt. Sgt. V. E. Norman; F/O. J. A. Norton; Flt. Sgt. K. O. G. Nugent; Sgt. H. J. Ockorby; Sgt. G. J. O'Kane; Sgt. T. H. Oldroyd, Sgt. D. C. Orme; Flt. Sgt. G. L. Osmond-Jones; Flt. Sgt. A. C. Overett; Sgt. I. Parry; Flt. Sgt. E. J. Parsons; Sgt. A. Pascoe; W/O. O. J. Pawsey; F/O. C. L. Philpott; F/O. L. J. Philpott; Sgt. J. Picken; Sgt. E. T. Prior; Sgt. C. J. Reed; Sgt. J. D. Richmond; Sgt. W. Roberts; Flt. Sgt. H Ruston; W/O. K. R. Saywell; F/O. A. J. Seabrooke; F/O. J. L. Searl; P/O. F. B. Shaw; Flt. Lt. N. H. Shaw; F/O. P. Slater; Sgt. J. W M. Slaven; Sgt. F. J. Sloane; Flt. Sgt. B. Smith; Flt. Sgt. E. W. Smith; Sgt. F. S. R. Smith; F/O. J. W. Smith; F/O. J. E. Spetch; Flt. Lt. E. J. D. Stanley; P/O. A. J. M. Starr; Flt. Lt. F. J. Stratton; F/O. E. J. Stubley; W/O. F. H. Swinson; Sgt. V. N. Taylor; P/O. C. E. Terrell; F/O. M. J. Thain; Sgt. A. A. Thistlethwaite; Flt. Sgt. J. Thompson; Sgt. J. V. Thompson; P/O. F. G. Totterdell; F/O. F. G. Waring; Sgt. W. J. Warlow; Sgt. A. P. Webb; F/O. E. A. Welch; Sgt. J. M. Wemyss; F/O. D. J. K. White; Flt. Sgt. N. A. White; Sgt. E. Wilcox; Sgt. R. V. S. Wilson; Flt. Lt. W. D. Wright; Flt. Sgt. H. G. Wynn.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Sgt. S. C. Biggs.

MISSING.—Sgt. G. A. Boddy; F/O. C. R. A. Browning; Sgt. P. Cumberworth; F/O. W. S. Lees; Sgt. S. W. Martin; Sgt. J. O. E. Ogden; P/O. J. C. Prince; Sgt. E. C. M. Selley; F/O. K. F. Sidwell, D.F.C.; F/O. E. A. Smith; Flt. Sgt. J. Thursfield; Sgt. R. J. Trebble; Flt. Lt. N. C. Trigg; Flt. Lt. H. Wroe.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—F/O. K. W. Bennett; Cpl. J. J. A. Botting; W/O. G. G. Jessup; F/O. H. J. Platts.

KILLED ON ACTIVE SERVICE.—Cpl. L. C. Adams; W/O. J. Crosland; W/O. J. D. Garrett; Sgt. A. Greenwood; F/O. L. I. McDougall; L.A/C. R. Pooley; F/O. R. G. W. Portas; F/O. S. F. E. Sara; Flt. Lt. A. C. Tyler.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. A. Appleby; L.A/C. J. Chicken.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. R. H. Beer; Flt. Sgt. L. E. H. Blay; Sgt. J. Bruce; Sgt. I. D. B. Danks; Sgt. T. F. Green; Flt. Sgt. R. E. Herbert; Sgt. C. B. Horridge; Sgt. N. P. Hitchcock; Sgt. H. J. King; Sgt. L. Knighton; Sgt. D. Morrison; Sgt. A. Robertson; Sgt. P. I. Spencer.

DIED ON ACTIVE SERVICE.—L.A/C. W. T. Allen; A/C.1 E. J. Allfrey; L.A/C. B. C. Ambler; L.A/C. W. Annani; Sgt. R. D. Astley; L.A/C. G. M. Ball; L.A/C. J. Ball; A/C.2 A. W. B. Ballinger; L.A/C. H. Beardshaw; W/O. R. G. Bentley; L.A/C. R. A. Blackler; Sgt. G. A. Blake; Sgt. P. J. Brett; A/C.1 A. E. Brown; L.A/C. G. F. Brown; Cpl. F. L. Bubb; L.A/C. J. Buzan; Flt. Lt. G. A. C. Carington; Flt. Sgt. A. Clark; L.A/C. A. Coker; F/O. R. G. Cranford; A/C.1 A. A. Crofts; A/C.1 N. Crosby; A/C.2 J. P. Devon; L.A/C. R. W. Duffield; F/O. A. Ellis; L.A/C. I. M. Evans; A/C.2 F. R. Faulkner; A/C.1 D. J. Fisk; Flt. Lt. W. M. Franklin, D.F.C.; Sgt. R. H. Giles; L.A/C. D. G. Gillard; A/C.2 E. H. S. Haig; A/C.1 E. Hardy; L.A/C. H. A. Hardy; A/C.1 T. Harper; L.A/C. A. T. Harris; Cpl. H. W. Harrodine; A/C.1 J. W. Hawell; F/O. C. E. Head; Cpl. M. G. Heap; A/C.1 T. H. Higgins; Cpl. E. Horler; A/C.1 W. Hutchinson; A/C.2 J. Kane; Cpl. R. A. Kemp; Sqn. Ldr. F. J. Knowler; L.A/C. R. L. Laywood; A/C.1 A. Levy; A/C.1 D. V. Loader; Act. Sqn. Ldr. D. Moulden; Cpl. T. Musty; Flt. Lt. R. G. Newton; Cpl. A. E. Nichols; L.A/C.

Badge of No. 295 Squadron Royal Air Force — "Ex Caelo Auxilium" (Aid from Above).

PROJECT RUBY: Under this intriguing U.S. code name Superfortresses and Fortresses of the U.S.A.A.F. are co-operating in deep-penetration bombing trials, as described on pages 537-539. Here Lt. Col. D G. Hawes (centre), officer commanding the U.S. Contingent, greets (left to right) Group Capt. Simpson, Air Comdre. Spencer, Air Marshal Sir Norman Bottomley and Group Capt. Patmore. The Superfortress modified to carry a 22,000-lb. "Grand Slam" is a fitting background.

SERVICE AVIATION

W. C. Pegler; W/O. F. Perriam; L.A/C. G. J. S. Perry; L.A/C. A. Plenderleith; Cpl. F. Rolfe; L.A/C. A. A. M. Russell; L.A/C. R. E. Taber; A/C.2 R. H. Taylor; L.A/C. G. R. J. Torode; L.A/C. V. D. Venn; Cpl. G. G. Williams; A/C.2 J. L. Williams; F/O. J. L. Wilson; Cpl. W. L. Wright; L.A/C. A. R. Wyatt; Sgt. K. T. Wylie.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. B. E. V. Chantler; L.A/CW. R. E. Lewis.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. P. J. Ambrose; Act. F/O. C. S. Bogle; W/O. K. M. Bright; Act. F/O. R. T. Kerwin; Flt. Sgt. J. R. McIntyre.

Royal Canadian Air Force

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. M. Reeves.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. M. Atchison; P/O. D. C. McNie; F/O. J. A. Russell; F/O. F. E. Seaby; F/O. K. G. Thomas; F/O. H. M. Weaver.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. P. G. Bignell; Act. F/O. T. S. A. Tarrant.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. P. F. Allwright; Flt. Lt. A. S. Anderson; F/O. L. V. Davidson; P/O. C. R. Marriott; F/O. M. A. Milich; F/O. F. A. Rutherford; Act. Flt. Lt. F. G. Sanders; F/O. C. Stevenson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. A. Young.

South African Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—2/Lt. P. G. Coutts; Lt. L. W. Douglass; Capt. E. A. Endler; Lt. H. T. Funkey; W/O. D. M. Hamilton; 2/Lt. D. Joan; W/O. A. A. Jordan; Lt. A. G. McCabe; Lt. J. J. Paola; Lt. T. A. Stewart; W/O. J. W. Thompson; Lt. P. R. Van Rensburg; 2/Lt. L. A. Verity.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. G. M. A. Denham; Lt. D. B. Dick; Lt. W. E. Ellis; Lt. D. A. Farquhar; W/O. G. J. Geloenhuys; Flt. Sgt. H. D. Lugg; Lt. G. Meaker.

Casualty Communique No. 584

Of the names in this list, 297 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. R. J. Beckett; Sgt. D. Conroy; F/O. E. G. Hill; Sgt. J. R. McDowell; F/O. F. D. McGonigle.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. D. C. Allen; Sgt. E. B. Barradell; Sgt. C. F. Bates; P/O. J. R. Baxter; F/O K. T. Bell; Sgt. A. C. Benham; Flt. Sgt. W. Bernard; F/O. T. B. Booth; Flt. Sgt. N. G. G. Carn; Flt. Sgt. J. Cass; W/O. K. J. Clarke; Sgt. J. Clayton; Sgt. O. A. M. Cook; Sgt. F. Cowell; Flt. Sgt. R. G. Cunningham; Sgt. G. Dacey; P/O. A. D. Danson; Flt. Sgt. N. T. Deacon; Act. F/O. E. H. S. Dorey; P/O. G. D. Evers; Sgt. D. W. Farrar; W/O. C. H. M. Foster; Sgt. E. N. J. Francis; Sgt. J. V. C. Funnell; W/O. M. G. George; Sgt. E. J. Gibson; Act. Sqn. Ldr. H. Gorton; Sgt. A. H. Grant; Flt. Sgt. R. I. Gray; Sgt. F. J. B. Gwynne; Flt. Sgt. H. Hall; Sgt. C. M. Hanna; Sgt. A. J. Hannah; Flt. Sgt. W. G. Hannon; F/O. J. H. G. Harland; Sgt. W. Harris; Sgt. G. F. Haslam; Flt. Sgt. W. H. Holbrook; Flt. Sgt. E. Holland; Sgt. S. G. Hone; Sgt. N. R. Howell; Act. F/O. G. E. Illingworth; P/O. G. A. Jackson; Flt. Sgt. R. D. Jerrard; P/O. F. E. John; Sgt. H. C. Johnston; Sgt. J. B. M. Kelleher; Sgt. J. S. Kewell; Sgt. C. G. Lees; Sgt. E. Left; Sgt. H. Lockett; Flt. Sgt. B. E. Longhurst; Sgt. S. D. Lucas; Act. F/O. J. M. Lyons; F/O. W. McQuade; Flt. Sgt. A. Marquis; L.A/C. I. B. Martin; Sgt. D. N. Mepham; Sgt. R. Middleton; Flt. Sgt. A. Morris; Flt. Sgt. E. Morris; F/O. D. Myers; Sgt. R. C. Osman; Sgt. W. Osmond; Flt. Lt. A. E. Palmer; Sgt. R. McK. Paterson; F/O. R. G. Picton; Sgt. W. E. Pike; W/O. W. Poston; W/O. E. J. Prince; Flt. Sgt. J. Purdham; Sgt. H. L. Richman; P/O. F. V. Robinson; P/O. E. H. Russell; F/O. C. J. Sanders; Flt. Sgt. G. D. Savage; Sgt. D. H. Scott; Sgt. N. G. Simpson; Sgt. L. Slocombe; Act. Flt. Lt. R. L. Strachan; Sgt. D. Sykes; Flt. Sgt. H. J. E. Syme; F/O. H. L. J. M. Taymans; Flt. Sgt. J. Thomson; F/O. L. A. Thorpe; P/O. F. Tingle; W/O. J. Towns, D.F.C.; Flt. Lt. L. J. Trapp; Flt. Sgt. W. Turnbull; Flt. Lt. E. H. A. Vernon-Jarvis, D.F.C.; P/O. E. F. L. Voce; Sgt. D. Ward.

KILLED ON ACTIVE SERVICE.—Sgt. H. G. McArthur; A/C.1 D. J. Shea.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. G. B. Gibson.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. B. W. Griffith.

DIED ON ACTIVE SERVICE.—A/C.1 R. W. Anderson; A/C.1 K. L. Barnett; A/C.2 L. Barraclough; Cpl. D. Blair; L.A/C. T. H. Bowles; Act. Cpl. D. Carroll; Cpl. I. Chapple; Sgt. E. Chatt; L.A/C. C. W. Checketts; L.A/C. D. H. Coates; Sgt. K. Connolly; A/C.2 K. F. Cosham; Act. Sqn. Ldr. B. Crosland; A/C.1 J. S. Cummings; Sgt. E. J. Daly; A/C.2 G. I. De Lange; A/C.1 K. J. Dransfield; L.A/C. D. V. Elliott; Flt. Sgt. M. E. Fendlen; Cpl. R. P. Fisher; F/O. G. S. Forbes; L.A/C. E. F. Garrad; Sgt. J. Grant; A/C.2 J. Grant; A/C.2 R. W. Grice; Cpl. H. Hayes; L.A/C. J. E. Herbert; L.A/C. J. Hodkin; W/O. L. Hopwood; A/C.2 S. B. Horne; A/C.2 W. H. Horobin; L.A/C. R. W. James; A/C.1 J. W. Johnson; L.A/C. R. W. Johnson; A/C.1 R. A. Johnson; Cpl. A. J. Kirby; A/C.1 W. Lefevre; A/C.1 H. F. Mansfield; A/C.1 L. Morris; A/C.1 G. Neal; L.A/C. A. W. C. Parfitt; L.A/C. T. B. Reakes; A/C.1 O. G. Roberts; Sgt. F. V. Simmons; A/C.1 W. Tucker; L.A/C. A. W. Turner; A/C.1 J. W. G. Turner; L.A/C. F. A. Venn; A/C.2 F. S. Worthington; Act. Cpl. C. A. Wright.

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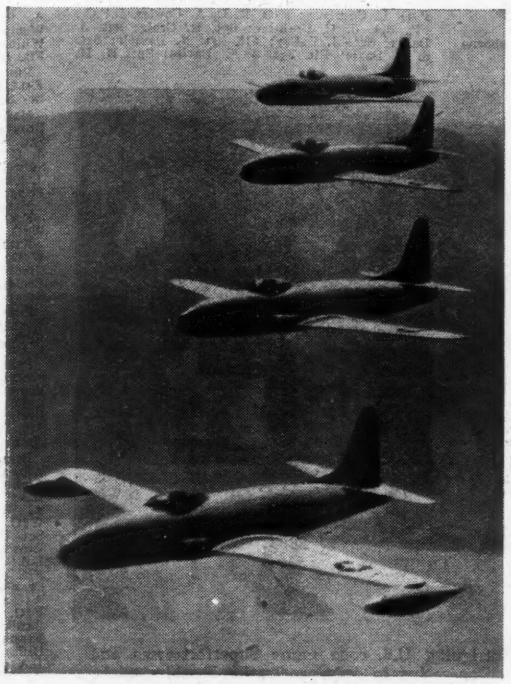

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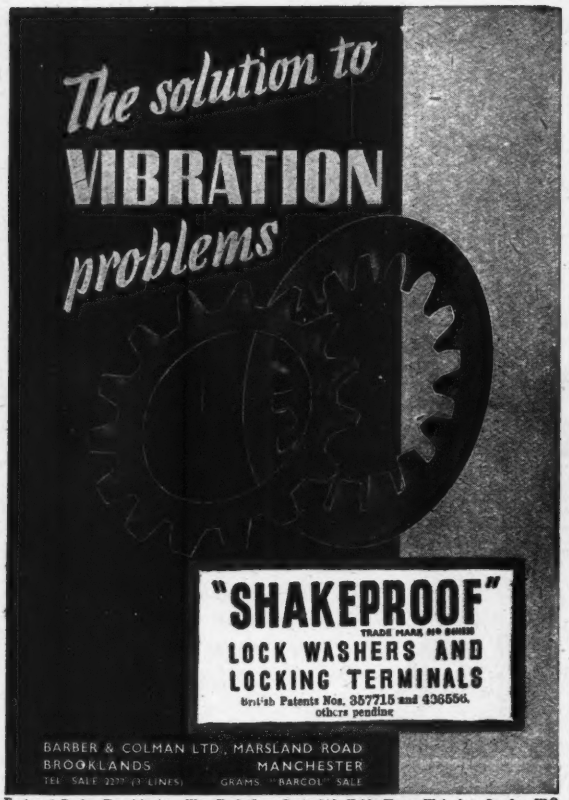

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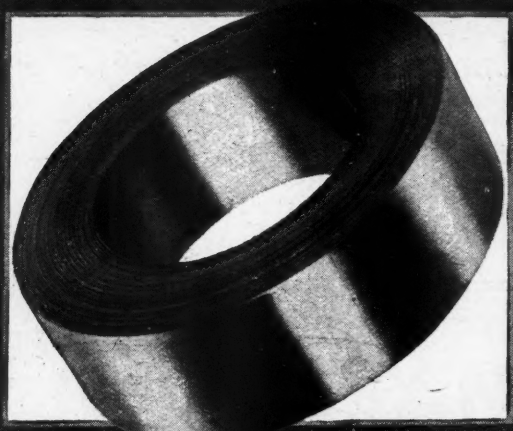

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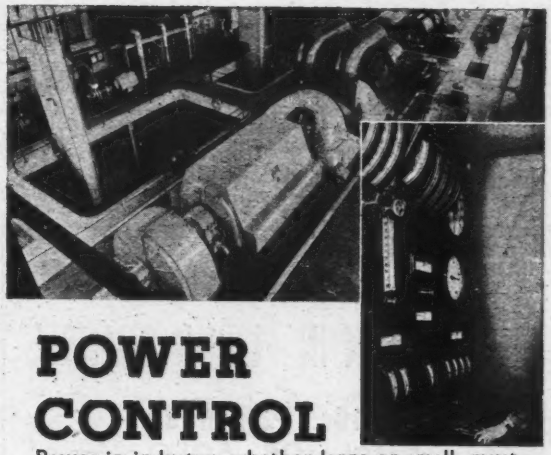

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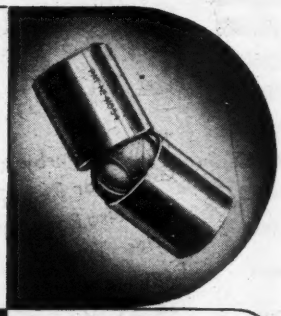

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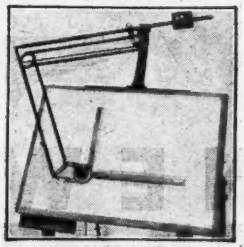

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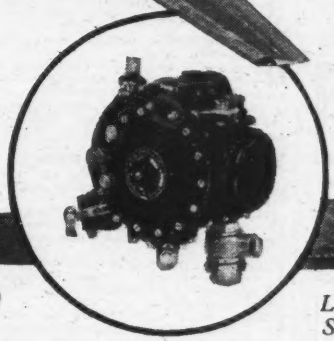

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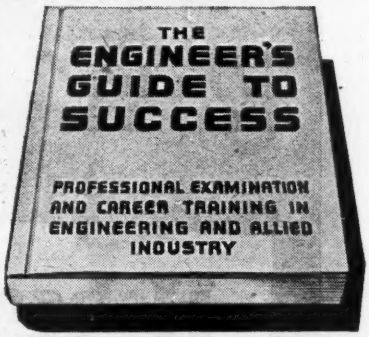

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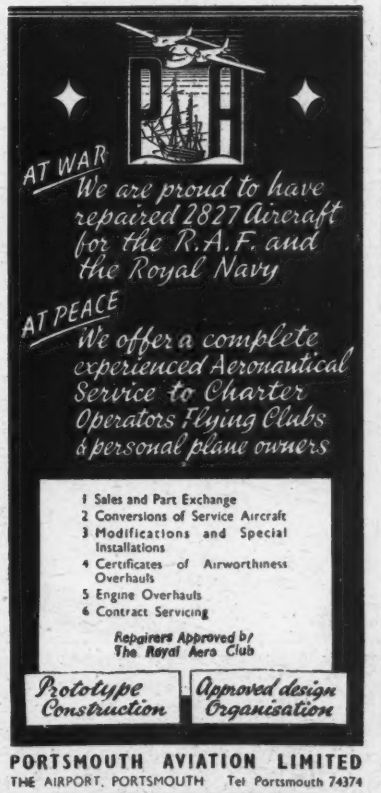
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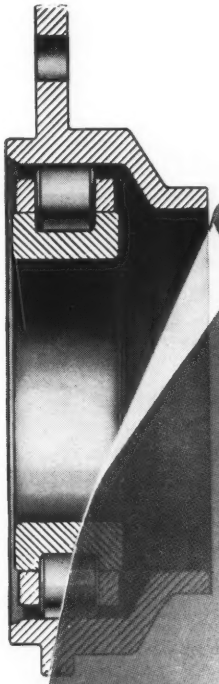

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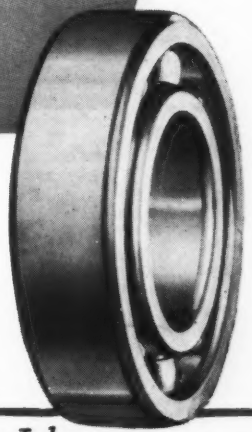

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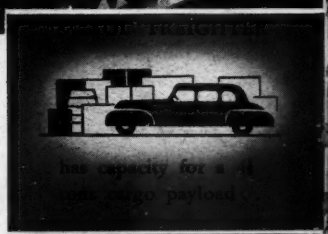

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